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MILITARY OPERATING AREA AND RANGE NOISE MODEL MR_NMAP USER'S MANUAL

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MR_NMAP (MOA Range NOISEMAP) is a general-purpose, PC-based omputer program that calculates the noise levels under Military Operating Areas (MOAs), Military Training Routes (MTRs), and Ranges. The calculations in MR_NMAP are based on a United States Air Force (USAF) dataset of measured aircraft noise levels called NOISEFILE. The program calculates standard noise metrics of Ldnmr, Ldn, CNEL, Leq, SEL, and Lmax. The noise levels are output as contours or in tabular format, and are suitable for inclusion in Environmental Impact Statements and Environmental Assessments. The computer model has a Microsoft WindowsTM based graphical user interface that allows the user to draw the airspace, specify areas of high/medium/low activity, and draw the specific flight tracks for bombing runs and military training routes. Menu features are used to enter the operation data and exercise other features of the noise model
Contained in this report are instructions on installing and using the computer program. A separate report, WR 95-18, "Noise Calculation Procedures Contained in the MOA Range NOISEMAP (MRNMAP) Computer Program" describes the noise models and presents results from experimental measurements that validate the noise models.

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ABSTRACT

MR_NMAP (MOA Range NOISEMAP) is a general-purpose, PC-based computer program that calculates the noise levels under Military Operating Areas (MOAs), Military Training Routes (MTRs), and Ranges. The calculations in MR_NMAP are based on a United States Air Force (USAF) dataset of measured aircraft noise levels called NOISEFILE. The program calculates standard noise metrics of L_{dnmr}, L_{dn}, CNEL, L_{eq}, SEL, and L_{max}. The noise levels are output as contours or in tabular format, and are suitable for inclusion in Environmental Impact Statements and Environmental Assessments. The computer model has a Microsoft Windows™ based graphical user interface that allows the user to draw the airspace, specify areas of high/medium/low activity, and draw the specific flight tracks for bombing runs and military training routes. Menu features are used to enter the operation data and exercise other features of the noise model.

Contained in this report are instructions on installing and using the computer program. A separate report, WR 95-18, "Noise Calculation Procedures Contained in the MOA Range NOISEMAP (MRNMAP) Computer Program" describes the noise models and presents results from experimental measurements that validate the noise models.

CHAPTER 1

INTRODUCTION

1.1 Overview

MR_NMAP (MOA Range NOISEMAP) is a general-purpose, PC-based computer program that calculates noise levels under Military Operating Areas (MOAs), Military Training Routes (MTRs), and Ranges. These levels are output as contours or in tabular format, and are suitable for inclusion in Environmental Impact Statements and Environmental Assessments. MROPS is a companion interface program that facilitates defining the airspace, specifying the aircraft types and operations, and controlling the computational features of MRNMAP. MROPS and MRNMAP, together with the contouring program NMPLOT, form a complete package for evaluating noise impacts under military airspaces.

Figure 1-1 shows the organization of the three modules which form the software package. The first module is MROPS. This is an interactive, Windows-based program which acts as the primary user interface. A series of menus and entry forms prompt the user for all required information. All data can be entered in tabular format. Geometric data such as airspace boundaries and flight tracks may alternatively be entered graphically using CAD-like features. The user may also draw upon databases which define all existing airspace components. This module manages data for various assessments and alternatives, and can be used to run the other modules.

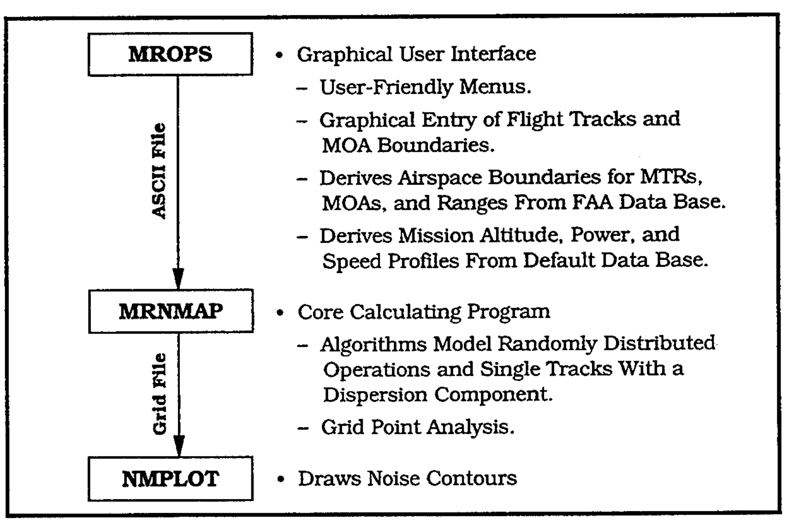


Figure 1-1. Overview of Computer Programs.

MRNMAP is the module which performs the noise calculations. It is a collection of building block noise models. All of the models are based on NOISEMAP technology, which embodies the physics of aircraft noise generation and propagation. Each model is structured so as to apply this technology to the way that aircraft fly in military airspace, and is optimized for the appropriate type of operation. From a modeling perspective, there are two main categories of aircraft operations: distributed operations, as are found in MOAs, and track operations, as are found on MTRs and target approaches. MRNMAP is designed to accommodate additional and/or updated models as technology advances.

The user generally will not interact with MRNMAP, but will access it through MROPS. When used in this manner, MRNMAP runs as a self-contained process using a data file created by MROPS for input. To simplify use by those with a specific need to run MRNMAP directly, to facilitate "chronicle" style auditing, and to allow use of MRNMAP with other software (such as the Air Force's ASAN system), the input data file is in ASCII format and has a well-defined, readable structure. As output, MRNMAP creates three files: a .TXT file (ASCII) which contains airspace, mission, and operations data, as well as the computed noise levels, in tabular format; a .GRD file (binary) which contains the airspace boundaries and the noise level contours; and a .MAP file (ASCII) which contains the noise levels in an ASCII raster text format. The third file is read by the Geographic Resources Analysis Support System (GRASS). GRASS is an integrated set of computer programs designed to provide image processing, map production, and geographic information system capabilities.

The third module, NMPLOT, is the Air Force's standard noise contour plotting program. The user will normally access NMPLOT through MROPS, but may interact with it directly to specify the layout of the graphical output. NMPLOT processes the .GRD file output by MRNMAP.

1.2 Manual Layout

Chapter 1 of this manual includes the system requirements for MROPS, MRNMAP, and NMPLOT, as well as instructions for installation of the programs. Chapter 2 contains a review of military airspace and flight operations terminology. This information is essential for the proper use of MROPS. Chapter 3 includes step-by-step instructions for entering data into MROPS and running the three programs. Chapter 4 is the reference manual for MRNMAP. It includes the contents and format of the input data file, as well as technical information on the incorporated noise models. This chapter may be bypassed by the reader who intends to perform all of the programs' functions through MROPS.

Appendix A contains the keyword format for the MRNMAP input file. Appendix B contains the aircraft identification codes derived from NOISEFILE, and the corresponding default power and speed settings.

1.3 System Requirements

1.3.1 Windows Version

The following table lists the system requirements for the Windows versions of MROPS, MRNMAP, and NMPLOT.

Category	Requirement
Hardware	16- or 32-bit x 86-based microprocessor (such as an Intel 80386/25 or higher)
	VGA or higher resolution video display adapter
	Hard disk with 6 megabytes (MB) minimum free space
	High-density floppy drive
	Mouse or other pointing device (optional)
Memory	4 MB recommended minimum
Software	Microsoft Windows Version 3.1 or higher

1.3.2 Windows NT Version

The following table lists the system requirements for the Windows NT versions of MROPS, MRNMAP, and NMPLOT.

Category	Requirement
Hardware	32-bit x 86-based microprocessor (such as an Intel 80386/25 or higher)
	VGA or higher resolution video display adapter
	Hard disk with 6 megabytes (MB) minimum free space
	High-density floppy drive
	Mouse or other pointing device (optional)
Memory	12 MB recommended minimum
Software	Microsoft Windows NT version 3.1 or higher

1.4 Installation

To install MROPS, MRNMAP, and NMPLOT, insert Disk 1 into your floppy drive. From Windows (or Windows NT), choose the **Run...** option under the **File** menu. Type A:SETUP, and press return. You will be prompted to insert Disk 2 midway through the installation process. The SETUP program will create the proper directory structure and copy all necessary files to the appropriate directories. These directories include: a main directory (usually C:\MRNMAP) which contains the Windows (or Windows NT) version of MRNMAP (MRNMAPX.EXE), MROPS, and the aircraft, airspace, and NOISEFILE databases; a DOSVER subdirectory which contains the DOS version of MRNMAP; an NMPLOT subdirectory which contains the NMPLOT program and all of its associated files; and a SAMPLES subdirectory which contains four sample MRNMAP input files.

Once the SETUP program is done, you must make two additions to your AUTOEXEC.BAT file. These are:

1. Add the line SET NOISE=C:\MRNMAP.
2. Add C:\MRNMAP to the PATH statement.

These additions are necessary to run MRNMAP from multiple directories, and for MROPS to access MRNMAP and NMPLOT. If you install the software into a directory other than C:\MRNMAP, substitute that directory name in the additions above. You must reboot your computer or rerun AUTOEXEC.BAT for these changes to take effect.

CHAPTER 2

TERMINOLOGY

The user should be familiar with certain terms and concepts which pertain to military airspace, flight operations, noise, and map projection before attempting to use MROPS. This chapter contains a brief review of the necessary information. Section 2.1 describes airspace and flight operation definitions. Section 2.2 describes the noise metrics available in MRNMAP. Section 2.3 describes the Universal Transverse Mercator (UTM) map projection.

2.1 Definitions

A Military Operating Area (MOA) is a defined volume of airspace designed for use by military aircraft which can be generally described as having an altitude structure anywhere from the surface up to, but not including, 18,000 feet mean sea level (MSL). MOAs are established to contain certain military activities such as air combat maneuvers, instrument operations, intercepts, acrobatics, etc. However, hazardous activities, such as release of weapons, are not authorized in a MOA.

A Military Training Route (MTR) is a defined volume of airspace designated for use by military aircraft which can be generally described as having an altitude structure below 10,000 feet mean sea level (MSL) and having military aircraft operations in excess of 250 knots indicated airspeed (KIAS). MTRs are divided into two sub-types: visual routes (VRs) and instrument routes (IRs). Operations on visual routes are conducted only when the weather is at or above Visual Flight Rule minimums of five miles or more visibility and a weather ceiling of 3,000 feet or more. Operations on instrument routes can be conducted in instrument meteorological conditions.

A restricted area is defined as an airspace of specific dimensions where activities, either in the air or on the ground, must be confined because of their nature and which may be considered hazardous to non-participating aircraft. A range is defined as a portion of the ground under a restricted area that must be available to contain both the weapons delivered and the aircraft flight paths during the delivery of those weapons. In this document and in the programs, the term range is used to describe the restricted area, as well as the ground underneath it.

Bombing track is a term used in this document and in the programs to describe uncharted flight tracks. A bombing track is defined as a generic track that is composed of straight segments and turns. Operations on a bombing track may be distributed across the track, as they are on MTRs.

An avoidance area is a volume of airspace where military flight operations are prohibited. MROPS and MRNMAP assume avoidance areas to be vertical cylinders, and thus defined by a center point, a radius, and an altitude.

The phrase airspace component is used in this document to describe one of any of the preceding types of airspace, while the phrases airspace scenario and airspace model are used to describe a collection of any or all types. The term mission is used to describe the use of one or more aircraft with a particular objective, such as close air support or air combat maneuvers. An operation or sortie is defined as the activity of one aircraft from initial takeoff to final landing. The term distributed operations is used to describe operations that are uniformly distributed in the horizontal plane. Distributed operations assume that the time spent within the boundaries of the airspace is uniform throughout. Standoff distance is defined as the inward distance from the boundary of a MOA or range where aircraft begin to turn to avoid overflying the boundary.

2.2 Noise Metrics

The noise environment under MOAs, Ranges, and MTRs is unique in several respects. Aircraft overflight events are highly sporadic, ranging from 20 to 30 per day to 10 or less per week. This differs from civilian airport noise exposure scenarios where events from commercial aircraft traffic tend to be continuous or somewhat regular. Individual noise events from military aircraft training in military airspace are also different from typical commercial aircraft noise sources because the frequent combination of low altitude and high speed can result in very rapid onset.

The primary noise metric used in this model is the onset rate-adjusted monthly day-night average A-weighted sound level, L_{dnmr}. This noise metric is based on an integration period equal to one calendar month and uses the month with the highest number of operations. This cumulative noise metric was developed after laboratory studies found that an overflight's annoyance rating is dependent on the event's onset rate, as well as its sound exposure level.[1,2,3,4]

MRNMAP can optionally generate output in six other noise metrics. These are equivalent continuous sound level, L_{eq}; day-night average sound level, L_{dn}; community noise equivalent level, CNEL; maximum A-weighted sound level, L_{max}; sound exposure level, SEL; and rate-adjusted sound exposure level, SEL_r. The L_{eq} is the level of a constant sound which, in a stated period and at a stated location, has the same A-weighted sound energy as a time-varying sound. L_{dn} is the equivalent continuous sound level, in decibels, for a 24-hour period from midnight to midnight, obtained after the addition of 10 dB to sound levels from 10:00 p.m. to 7:00 a.m. CNEL is similar to L_{dn} with the additional adjustment of 5 dB to sound levels from 7:00 p.m. to 10:00 p.m.. L_{max} is the highest instantaneous sound level observed during a single noise event no matter how long the sound may persist. SEL represents the constant sound level which, in one second, would produce the same acoustic energy as did the actual noise event. Most aircraft flyover events typically last longer than 1 second, and the SEL value will be higher than the maximum sound level of the event.

2.3 Universal Transverse Mercator Projection

The Universal Transverse Mercator (UTM) projection was adapted by the U.S. Army in 1947 for designating rectangular corners on military maps of the world. Between latitudes of 84°N and 80°S, the earth is divided into 60 zones each having approximately 6° wide zones. The bounding meridians are evenly divisible by 6° and zones are numbered from 1 to 60, proceeding each from the 180th meridian from Greenwich. Letter designations are used from South to North. For example, Washington, D.C., is located in grid zone 18S covering the quadrangle from longitude 72° to 78°W and from 32° to 40°N. Each of the quadrangles is further divided into a grid square 100,000 meters on a side with double-letter designations, including partial squares at the grid boundaries. Figure 2-1 shows a cylindrical projection of the world with the grid zone designations. The vertical lines denote the grid zone boundaries and the horizontal lines are the 100,000 meters on a side partial square boundaries.

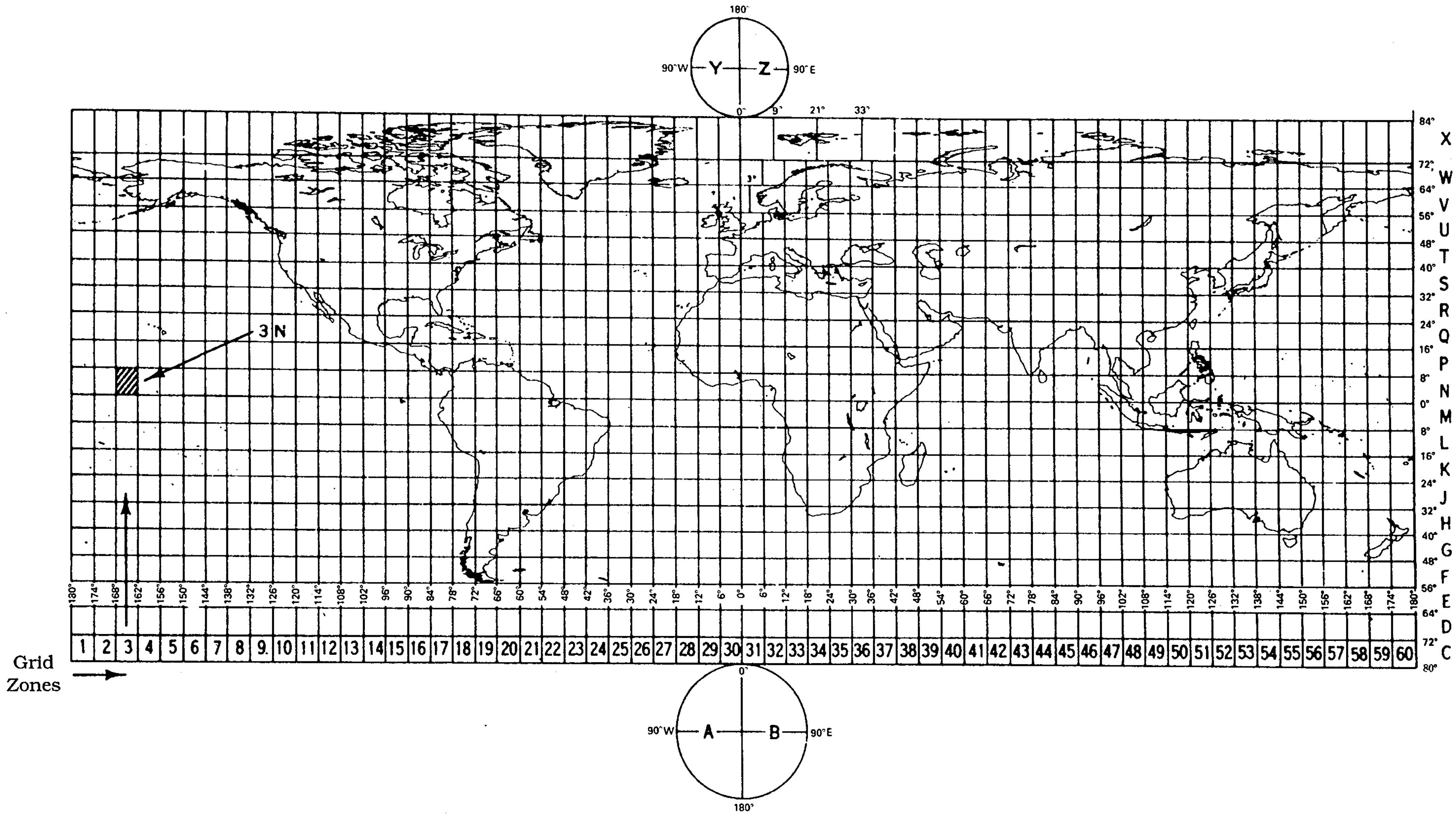


Figure 2-1. Universal Transverse Mercator (UTM) Grid Zones.

CHAPTER 3

USING MROPS

MROPS is the user interface for the MRNMAP noise modeling program. It allows quick and efficient building of MRNMAP input files, and provides the data entry, noise calculations, and contouring capabilities under a single "umbrella" program. This chapter contains instructions for entering data into MROPS, editing previously entered data, and running MRNMAP and NMPLOT from MROPS.

3.1 Getting Started: Defining A Workspace

Clicking on the MROPS icon starts the program in a maximized (full screen) window, with "MROPS-[untitled]" as the title of the window. (The title will display the name of a data file once it has been saved.) This window is divided into four major sections: the main menu, the data bar, the graphics area, and the status bar. The main menu contains options for file manipulation, adding and editing data, running MRNMAP and NMPLOT, and getting help. The data bar displays the coordinates of the mouse (see Section 3.7). The graphics area contains a map of the currently loaded airspace model. The status bar displays a message for each menu item, describing its use as it is chosen.

The first step in creating an airspace model is to define the study area where the MOAs, MTRs, ranges, etc., exist, i.e., the workspace or grid. This is done through the **Grid Specifications** option under the **Airspace** menu. Choosing this menu item brings up a dialog box which allows you to enter the lower left and upper right corners of the workspace in latitude and longitude coordinates. These coordinates will designate a rectangular grid space within which MRNMAP will calculate the noise levels. Each available data field in this dialog box must be filled (use 0s if necessary) in order to continue.

The workspace should be roughly twice as wide (longitudinally) as it is high (latitudinally). If this is not the case, the coordinates of the upper right corner will be recalculated, and the workspace will be stretched to approximate these dimensions. The size and location of the workspace must remain fixed throughout the processing of an individual case, so care should be taken in choosing appropriate corner coordinates.

Note that the remainder of the **Airspace** menu, the **Edit** menu, the **Operations** menu, and the **Tools** menu remain inactive (grayed) until the **Grid Specifications** data are entered. MROPS cannot build an airspace without this information.

3.2 Grid Granularity

The **Grid Specifications** dialog also allows you to choose a fine or coarse granularity. This option is used by MRNMAP in calculating noise levels and creating contours. Choosing a "coarse" granularity (the default) instructs MRNMAP to perform calculations on 10,000 evenly distributed points within the grid, and allows for faster run time. The "fine" granularity allows for 50,000 grid points, and although slower, creates more precise results.

3.3 Conditions

The second item in the **Airspace** menu is the **Conditions** option. This allows you to specify average daily temperature and relative humidity, as well as the number of flying days per month, and the mean ground elevation of the grid in feet above mean sea level (MSL). The mean ground elevation is used to calculate MTR floors which are specified in MSL in the MTR database. Since MRNMAP requires all altitude values in feet above ground level (AGL), MROPS subtracts the mean ground elevation from all values specified in feet MSL.

3.4 Adding Airspace Components

Once the workspace has been specified through the **Grid Specifications** menu item, airspace components may be added. These components are divided into five major categories: Military Operating Areas (MOAs), Military Training Routes (MTRs), Ranges, Bombing Tracks, and Avoidance Areas. Each type of airspace has a characteristic set of attributes, and thus is entered into MROPS through its own corresponding menu option.

3.4.1 Adding Military Operating Areas

A MOA is added by choosing the **MOA** option from the **Airspace** menu, which will bring up the **MOA Identification** dialog box. This dialog requires the MOA name, which is limited to 25 characters, and the floor and the ceiling, which must be given in feet AGL. Once these values have been supplied, you must choose a source for the MOA boundary points by selecting one of the three buttons located on the right-hand side of the dialog box. These buttons allow boundary data to be retrieved from a database of existing MOAs, or manually entered using either the mouse or the keyboard.

Database retrieval is used to add an existing MOA to the workspace. This is done by supplying MROPS with the name of the MOA, and clicking on the **Database** button. An asterisk (*) may be used as a wild card if the exact name is not known, but it must occur as the last character in the name. For example, entering BULL* in the name field and clicking the **Database** button will initiate a search for all MOAs whose first four letters are BULL. If a wild card is used and multiple MOAs match the partial name specified, MROPS will provide a list of those, from which one must be chosen. If no MOAs match the specified name, a warning message will be displayed. Once the MOA has been successfully retrieved, pressing the **OK** button will accept the data. Pressing the **Cancel** button at any time will abort the retrieval process.

A new MOA can be added to the workspace through either of two methods: drawing the MOA with the mouse, or manually specifying the latitude and longitude coordinates of each boundary point.

To draw a MOA, bring up the **MOA Identification** dialog box as described above, and enter the necessary data. Once this is done, click on the button labeled **Mouse**. This will place MROPS into the drawing mode, which is indicated by the appearance of the mouse's coordinates in the data bar. To define a boundary point, move the cursor to the desired coordinates, and click the left mouse button. As each successive point is designated, a blue line will connect it to the previous point, and a black "rubber-banding" line will connect it to the current mouse position. When finished, click the right mouse button to connect the first and last points of the MOA and redisplay the **MOA Identification** dialog. At this point you may edit the name, floor, or ceiling, press **OK** to accept the MOA, or **Cancel** to abort.

To manually enter the latitude and longitude of each point, bring up the **MOA Identification** dialog as described above, enter the name, floor, and ceiling, and click on the **Keyboard** button. This will display a dialog box entitled **MOA Boundary Point**, which accepts latitude and longitude values in degrees, minutes, and seconds. Each available data field on this dialog must be filled (use 0s if necessary) in order to continue. Click the **Next** button to connect the current point to the previous point with a blue line and clear the data fields for the next point. To complete the keyboard entry of a MOA, click the **Done** button *while the coordinates of the last point are still visible on the dialog.* Do not use the **Next** button to process the last point. Pressing the **Done** button will redisplay the **MOA Identification** dialog; press the **OK** button to accept the data, or the **Cancel** button to abort.

3.4.2 Adding Military Training Routes

An MTR is added to MROPS through the **MTR** option from the **Airspace** menu, which will bring up the **MTR Identification** dialog box when chosen. This dialog requires entry of the MTR name, which is limited to 25 characters. Once the name has been supplied, you must choose a source for the MTR data (which consists of boundary or turn points, left and right route widths or the route standard deviation, and the route floor) by selecting one of the three buttons located on the right-hand side of the dialog box. These buttons allow the MTR data to be retrieved from a database of existing MTRs, or manually entered using either the mouse or the keyboard.

To add an existing MTR to the workspace, enter the name of the MTR in the data entry field and click the **Database** button. Wild cards can be used, e.g., entering VR-01* for the MTR name. If the entire name is entered, it must be of the format VR-xxxx or IR-xxxx where 'xxxx' represents a four-digit number, e.g., VR-0096 or IR-1023. The database stores the MTR names only in this format, so using another format will result in an 'MTR not found' message. Multiple matches to a wild card will produce a list from which one MTR can be chosen at a time. Once the database lookup is complete, click on the **OK** button to accept the MTR, or **Cancel** to abort.

During the retrieval process of an MTR, MROPS attempts to translate the free-form text altitude descriptions for each segment into valid AGL floor values. If this is not possible, MROPS will continue the process, but will also display a warning that one or more floor values were set to 99999 due to an inability to extract the actual value. If this should occur, you should accept the data using the **OK** button, then edit the incorrect values at a later time using either the MROPS edit features (see Section 3.8.2), or a commercial editor.

A new MTR can be added to the workspace through either of two methods: drawing the MTR with the mouse, or manually specifying the latitude and longitude coordinates of each boundary point.

To draw and MTR, click on the button labeled **Mouse** on the **MTR Identification** dialog. Use the left mouse button to designate a turn point; this will bring up a dialog box labeled **MTR Segment Data**. This dialog displays the turn point's coordinates, the optional point identifier, left and right widths, standard deviation (sigma), and the segment floor. Values for the widths, sigma, and floor can be entered manually using the keyboard, or by clicking the mouse on the up and/or down arrows associated with each value. There are also two "radio buttons" on this dialog, one next to the left width value and the other next to the sigma value. Clicking on the former will store the left and right route widths as specified. Clicking on the latter will store only the standard deviation, which is applied by MRNMAP across the entire route. The first occurrence of the **MTR Segment Data** dialog displays default values for each of the segment's attributes. Each subsequent occurrence displays the attributes of the previous segment to minimize data entry for routes with constant floors, widths, etc.

To continue on to the next turn point, click the button labeled **Line**. This activates the rubber-banding feature, which displays the segment from the last point to the current cross-hair position. A solid black line will connect the points as they are specified. The **Cancel** button deletes the data for the current segment, and backs up to the previously designated point. After entering the data for the final segment designated by clicking on the right mouse button, click on the **Line** button. This will redisplay the **MTR Identification** dialog. Choose **OK** to accept the MTR, or **Cancel** to abort.

To enter the MTR coordinates manually, choose the **Keyboard** button on the **MTR Identification** screen. This will bring up a dialog box entitled **MTR Point**, which has entry fields for latitude and longitude coordinates. Each field must be populated before processing can continue (use 0s if necessary). Choosing the **Next** button will display the **MTR Segment Data** dialog, just as if you were using the mouse and pressed the left mouse button. Populate the fields in this dialog, then press the **Line** button to return to the **MTR Point** dialog for the next set of coordinates. To complete the data entry process, click the **Done** button *while the coordinates for the last turn point are still visible.* This will display the **MTR**

Segment Data dialog which corresponds to the end point of the MTR. Clicking on the **Line** button will then redisplay the **MTR Identification** dialog, where the final choice to accept (**OK**) or abort (**Cancel**) is made.

3.4.3 Adding Ranges

The third major type of airspace is the range. A range is added by choosing the **Range** option from the **Airspace** menu, which will bring up the **Range Identification** dialog box. This dialog requires the range name, which is limited to 25 characters, and the floor and ceiling, which must be given in feet AGL. Once these values have been supplied, choose a source for the range boundary points by selecting one of the three buttons located on the right-hand side of the dialog box. These buttons allow boundary data to be retrieved from a database of existing ranges, or manually entered using either the mouse or the keyboard.

Database retrieval is used to add an existing range to the workspace. This is done by supplying MROPS with the name of the range, and clicking on the **Database** button. To successfully retrieve a range from the database, the name must be of the format xxxx where 'xxxx' represents a four-digit number. Thus, to retrieve range R-5306, only 5306 should be entered for the name. An asterisk (*) may be used as a wild card if the exact name is not known, but it must occur as the last character in the name. For example, entering 32* in the name field and clicking the **File** button will initiate a search for all ranges whose first two characters are 32. If a wild card is used and multiple ranges match the partial name specified, MROPS will provide a list of those, from which one must be chosen. If no ranges match the specified name, a warning message will be displayed. Once the range has been successfully retrieved, press the **OK** button to accept the data. Press the **Cancel** button at any time to abort the retrieval process.

A new range can be added to the workspace through either of two methods: drawing the range with the mouse, or manually specifying the latitude and longitude coordinates of each boundary point.

To draw a range, bring up the **Range Identification** dialog box as described above, and enter the necessary data. Once this is done, click on the button labeled **Mouse**. This will place MROPS into the drawing mode, which is indicated by the display of the cross-hair cursor. To designate a boundary point, move the cursor to the desired coordinates, as indicated above the drawing area, and click the left mouse button. As each successive point is designated, a blue line will connect it to the previous point, and a black "rubber-banding" line will connect it to the current mouse position. When finished, click the right mouse button to connect the first and last points of the range and redisplay the **Range Identification** dialog. At this point you may edit the name, floor, or ceiling, press **OK** to accept the range, or **Cancel** to abort.

To manually enter the coordinates of the boundary points, bring up the **Range Identification** dialog as described above, enter the name, floor, and ceiling, and click on the **Keyboard** button. This will display a dialog box entitled **Range Boundary Point**, which accepts latitude and longitude values in degrees, minutes, and seconds. Each available data field on this dialog must be filled (use 0s if necessary) in order to continue. Once the coordinates have been entered, click on the **Next** button to clear the data fields for the next point, and connect the current point to the previous point with a blue line. To complete the keyboard entry of a range, click the **Done** button *while the coordinates of the last point are still visible on the dialog.* Do not use the **Next** button to process the last point. Click the **Done** button to redisplay the **Range Identification** dialog; click the **OK** button to accept the data, or the **Cancel** button to abort.

3.4.4 Adding Bombing Tracks

To enter a bombing Track, choose the **Bombing Track** item in the **Airspace** menu, which will bring up the **Bombing Track Identification** dialog. This dialog requires entry of the Bombing Track name, which is limited to 25 characters. Once the name has been supplied, you must choose a source for the Bombing Track data (which consists of boundary or turn points, left and right track widths or the track standard deviation, and the track floor) by selecting one of the two buttons located on the right-hand side of the dialog box. These buttons allow the Bombing Track data to be manually entered using either the mouse or the keyboard. Note that the **Database** button is not active; there is no database containing Bombing Track data.

To enter Bombing Track data using the mouse, click on the button labeled **Mouse** on the **Bombing Track Identification** dialog. Click the left mouse button to designate a turn point, which will bring up a dialog box labeled **Track Segment Data**. This dialog displays the turn point's coordinates, the optional point identifier, left and right widths, standard deviation (sigma), and the segment floor. Values for the widths, sigma, and floor can be entered manually using the keyboard, or by clicking the mouse on the up and/or down arrows associated with each value. There are also two "radio buttons" on this dialog, one next to the left width value and the other next to the sigma value. Clicking on the former will store the left and right route widths as specified. Clicking on the latter will store only the standard deviation, which is applied by MRNMAP across the entire route. The first occurrence of the **Bombing Track Segment Data** dialog displays default values for each of the segment's attributes. Each subsequent occurrence displays the attributes of the previous segment to minimize data entry for tracks with constant floors, widths, etc.

To connect the current point to the next point with a straight segment, click the button labeled **Line**. To connect the current point to the next point with a circular arc, click the **Curve** button. This brings up the **Turn Specifications** dialog; the turn is defined by its radius in nautical miles, and its angle in degrees, where a positive value represents a right-hand turn, and a negative value represents a left-hand turn. The separate values for entry and exit floors allow you to model a climbing or diving turn. Clicking on the **OK** button will cause the **Track Segment Data** dialog to appear, which is needed to provide the necessary data for the end point of the turn. After this segment's data has been entered, continue to add straight or curved segments as desired. Note that a bombing track cannot start with a curve, and curves cannot occur consecutively. The **Cancel** button on the **Track Segment Data** dialog deletes the data for the current segment, and backs up to the previously designated point.

After entering the data for the final segment designated with the right mouse button, click on the **Line** button. This will redisplay the **Bombing Track Identification** dialog. Choose **OK** to accept the Bombing Track, or **Cancel** to abort.

To manually enter Bombing Track coordinates, choose the **Keyboard** button on the **Bombing Track Identification** screen. This will bring up a dialog box entitled **Bombing Track Point**, which has entry fields for latitude and longitude coordinates. Each field must be populated before processing can continue (use 0s if necessary). Choosing the **Next** button will display the **Track Segment Data** dialog, just as if you were using the mouse and pressed the left mouse button. Populate the fields in this dialog, then press the **Line** or **Curve** button (for a straight or curved segment, respectively) to advance to the next set of coordinates. To complete the data entry process, click the **Done** button *while the coordinates for the last turn point are still visible.* This will display the **Bombing Track Segment Data** dialog which corresponds to the end point of the Bombing Track. Click on the **Line** button to redisplay the **Bombing Track Identification** dialog, where the final choice to accept **(OK)** or abort **(Cancel)** is made.

3.4.5 Adding Avoidance Areas

The fifth and final type of airspace is an avoidance area or "no-fly" zone. These avoidance areas, which are described with a central point, a radius, and a height, represent cylindrical pieces of airspace in which planes are not permitted to fly, and can represent towns, national parks, or any other area over which flights are restricted below a certain altitude.

To add an avoidance area to the workspace, choose the **Avoidance Area** option under the **Airspace** menu. This will bring up a dialog labeled **Avoidance Area** into which all of the necessary data can be input. Enter the name of the avoidance area (which is limited to 20 characters), the radius in nautical miles, and the height or ceiling in feet AGL. To enter the center point of the avoidance area with the mouse, click on the button marked **Draw**. This will close the data entry dialog, and put MROPS into drawing mode. Move the mouse to the desired location, and press the left mouse button. The avoidance area will appear as a red dot with a surrounding red circle positioned at a distance equal to the scaled radius from the center point. If you prefer to use the keyboard, enter the latitude and longitude coordinates of the center point in the fields provided and click the **OK** button. The avoidance area will again appear as a red circle with a red dot at the center. Click on the **Cancel** button to abort at any time.

3.5 Adding Mission Profiles

The next step in the data entry process is defining the mission profiles of the aircraft that fly in the airspace. This is done through the **Mission Profiles** menu. Choose the **User Defined** option to bring up the **Mission Profile** dialog into which all pertinent data is entered. First, input the mission name; this can be any alpha-numeric string up to ten characters in length, and by convention the name indicates the type of aircraft involved and the nature of the mission, e.g., "F-16 ACM" for F-16s flying air combat maneuvers. After entering the mission name, choose the aircraft type from the list provided in the **Aircraft Data** area on the left of the dialog. This can be displayed by clicking on the arrow next to the aircraft type data entry field with the mouse. Scrolling arrows are available to traverse the list. Click on the desired aircraft to fill the aircraft type field with that aircraft name, and the speed and power setting fields with the corresponding data. The speed and power settings are part of the aircraft database and cannot be changed by the user.

The altitude profile of the designated aircraft must also be entered in the **Altitude Bands** area on the right side of the dialog. At least one band must be specified, which is done by providing the floor and ceiling of the band in feet AGL, and the time spent in the band in actual minutes or percent. After the first band is specified, the floor of each subsequent band will be set to the ceiling of the previous band, so you need only enter the ceiling and time for bands other than the first. As is indicated by the dialog, a maximum of ten bands is allowed. When all of the necessary fields have been filled, click on the **OK** button to accept the data, or the **Cancel** button to abort.

3.6 Adding Operations

Operations data are used to assign numbers of sorties of the defined mission types to the individual airspace components in the scenario. Because of this, options under the **Operations** menu remain inactive until the airspace and mission data have been supplied.

To assign operations to a MOA or a range, choose the **Region** option from the **Operations** menu item. This will bring up the **MOA/Range Operations** dialog box, which is divided into two distinct areas: the left side of the screen pertains to the mission profiles, and the right side pertains to the airspace entities. The order of operations data entry is not significant, and in fact may vary depending on the format of the original data.

To specify the number of operations for a given mission, click on the desired mission name in the **Available Missions** list on the left side of the screen, then click on the **Add Mission** button located directly under the list. This will display the **Mission Operations** dialog box, which allows for the entry of day and night operations, as well as the time spent on the MOA or range. Operations can be entered in daily, monthly, or yearly values using the radio buttons in the **Frequency** box. Click the **OK** button to accept the data, or the **Cancel** button to abort. Repeat this process with all of the desired missions. It is not necessary to use all of the available missions.

Once the mission operations have been entered, they must be assigned to a particular piece or pieces of airspace. This is done by clicking on the desired airspace name in the **Available Airspace** list, and then clicking on the **Add Airspace** button. This will bring up the **Airspace Operations** dialog, where a percentage of the previously entered mission operations which should be assigned to the named airspace entity must be entered. This value should be greater than zero (although it can be equal to zero if necessary) and may be as large as necessary. MRNMAP will eventually multiply this percentage by the number of designated operations to get the actual number of operations associated with the given piece of airspace. Click the **OK** button to accept the percentage, or the **Cancel** button to abort. This process can be repeated as needed to assign the same list of operations (perhaps with different percentages) to numerous airspace entities.

As you add the operations and airspace data, they will appear in the lists across the top of the **MOA/Range Operations** dialog. Note that once an airspace appears in the **Selected Airspace(s)** list, it is removed from the **Available Airspace** list. This is to prevent a piece of airspace from being assigned two different sets of operations, which will cause an error in MRNMAP. When you are finished entering the operations data for the desired airspace entities, press the **OK** button to accept it. The **Cancel** button can be used to abort at any time. This entire process may be repeated as often as necessary to assign operations to as many airspace entities as desired.

To assign operations to an MTR or a bombing track, choose the **Track** option from the **Operations** menu, and follow the instructions above for adding operations data to a MOA. Note that time data is not required when assigning operations to an MTR or bombing track.

3.7 Additional Visual / Graphical Features

MROPS has a number of additional graphical features: the ability to add labels to the map, zooming capabilities for magnification and reduction of the map, a redraw option to minimize blurring during zooming, and cursor tracking abilities.

To add a label to the map, choose the **Label** option from the **Airspace menu.** This will display a sub-menu with choices for regions, tracks, and avoidance areas. Clicking on the **Regions** option will display a list of the MOAs and ranges which have been entered into MROPS. Click on the desired name, click on the **OK** button, move the cross-hair to the proper location, and press the left mouse button. This will place the chosen label below and to the right of the cross-hair. To label an MTR or a bombing track, choose the **Tracks** option from the labeling sub-menu, and follow the above instructions. Similarly, choose the **Avoidance Area** option from the labeling sub-menu to label an avoidance area.

Once the location of the grid has been input though the **Grid Specifications** dialog, MROPS zooms in on the lower left corner of the map. To zoom out and view the entire map, choose the **Zoom Out** option from the **Airspace** menu. This shrinks the map so it is entirely visible on the screen, and replaces the **Zoom Out** menu item with a **Zoom In** menu item, which allows you to return to the original zoom state. Note that while zoomed in, the scroll bars along the bottom and right-hand sides of the screen allow you to view different portions of the map. These scroll bars are not active in the zoomed-out state, since the entire map is visible.

Occasionally, multiple uses of the zoom feature will slightly blur the map. If this occurs, choose the **Redraw Screen** option from the **Airspace** menu to replot the map more clearly.

Clicking on the **Cursor Tracking** option under the **Tools** menu causes the coordinates of the cross-hair to be displayed at the top of the drawing area. The left-hand values are UTM coordinates, and the right-hand values are latitude and longitude. Clicking on it again turns the cursor tracking off.

Clicking on the **Coordinate Conversion** option under the **Tools** menu will display a submenu which performs coordinate conversion between Latitude/ Longitude and Universal Transverse Mercator (UTM) projections. Click on the radio button to change the direction of conversion. Then enter the known values and click on the **Convert** button.

3.8 Editing Data

Previously entered data may be edited through the **Edit** menu. This menu is comprised of six items, each pertaining to a specific type of information to be edited. These six are MOAs and ranges, MTRs and bombing tracks, avoidance areas, mission profiles, operations, and delete label.

3.8.1 Editing MOAs and Ranges

Choosing the **MOA/Range** option under the **Edit** menu displays a list box which contains the names of the previously entered MOAs and ranges. To edit information pertaining to a specific airspace component, click on the name of that component, then click the **Edit** button. This in turn will bring up the **MOA/Range Edit** dialog, where changes to, additions to, or deletions from the existing data may be made. The name, floor, and ceiling of the airspace are shown in the upper part of the screen, and may be changed at any time during the editing process. Note that if you change the name of the component, you must change that name where it appears in the operations data as well.

When the dialog is first displayed, the latitude and longitude of the first boundary point are shown in the lower part of the screen. To edit these coordinates, change the lat/long values as necessary. Clicking on the **Next Point** button will display the coordinates of the next boundary point, which are then available to edit. If you wish to insert a new boundary point anywhere in the list, click on the **Insert Point** button. This will clear the data fields for entry of the new point's coordinates. Once these new values are entered, click the **Next Point** button to continue traversing the list of boundary points, or the **Done** button to complete the editing process. Use the **Delete Point** button to remove the currently displayed point from the list. At any time, you may click on the **Done** button to accept the new data and end the editing process, or click on the **Cancel** button to abort the editing process and restore the original data. Once the editing is completed, the MOA or range will be redrawn with its new boundary.

3.8.2 Editing MTRs and Bombing Tracks

Choosing the **MTR/Bombing Track** option under the **Edit** menu displays a list of the MTRs and bombing tracks which are part of the currently loaded scenario. To edit the data associated with one of these, click on the desired name, then click on the **Edit** button. This will bring up the **MTR/Track Edit** dialog; this screen displays the name of the track near the top, which can be changed at any time during the edit process. Once again, care should be taken when changing the name of a track to also change the name in the operations data. The remainder of the data on the screen pertains to the first segment of the track. Note that for MTRs, the values in the **Turn Data** box will always be 0, since all MTR segments must be straight. Use the **Next Segment** button to advance to the next segment. Use the **Insert Segment** button to clear the data fields and enter a new turn point and associated segment data, or use the **Delete Segment** button to remove a segment from the track. Click on the **Done** button at any time to accept the new data, or the **Cancel** button to abort and restore the original track data.

3.8.3 Editing Avoidance Areas

To edit an avoidance area, choose the **Avoidance Area** option from the **Edit** menu. This will display a list box filled with the names of the avoidance areas currently loaded into MROPS. Click on the desired name, then click on the **Edit** button. This action will bring up a dialog which is identical in format and function as the dialog through which you added the avoidance area, which is filled with the appropriate data. To change the name, floor, or radius, simply overwrite the existing data. To change the location of the avoidance area, either enter the new latitude and longitude values and click on the **OK** button, or click on the **Draw** button, then click the left mouse button at the new location. Use the **Cancel** button to abort the editing process and restore the original data.

3.8.4 Editing Mission Profiles

Choosing the **Mission Profile** option under the **Edit** window displays a list of the mission profiles currently loaded into MROPS. To edit one of these profiles, click on the desired name, then click on the **Edit** button. This will bring up a dialog box which is identical to the one used to add the mission profile. To change the name of mission, type over the old name. If you change the name, you must also edit the operations data (see Section 3.8.5) which include the mission in question and change the name there as well. Use the list of available aircraft (which can be displayed by clicking on the arrow located next to the aircraft type data entry field) to change the type, speed, and power setting. Note that the speed and power settings will be changed automatically with a change in type. To change the altitude bands, retype the new floor, ceiling, and time values. Refer to Section 3.5, Adding Mission Profiles, for rules governing altitude bands. Click on the **OK** button to accept the new data, or the **Cancel** button to abort.

3.8.5 Editing Operations Data

Since the operations are divided into two distinct groups, those on MOAs or ranges, and those on MTRs or bombing tracks, the **Operations** item under the **Edit** menu contains a sub-menu which allows you to choose which of the two to edit. Choosing the **Regions** item brings up a list of the available MOAs and ranges; choosing the **Tracks** item displays a list of available MTRs and bombing tracks. Click on the name of the airspace whose operations you would like to edit, then click on the **Edit** button. This will bring up one of two **Operations Editor** screens, depending on which sub-menu item is chosen. The percent operations can be changed at any time, but a change in the name is not recommended unless the name of the airspace was changed when the airspace itself was edited. The lower portion of the screen contains the actual operations data, one mission at a time. Use the **Next Mission** button to skip to the next mission associated with the current airspace entity. Use the **Insert Mission** to add a new mission and corresponding operations. If this is done, the name of the inserted mission must match the name of a currently active mission. Use the **Delete Mission** button to remove unwanted operations. Note that if multiple airspace components are associated with the same list of operations, any change to the operations will affect *all* of the components. Click on the **OK** button to accept the changes you have made, or the **Cancel** button to abort and discard the changes.

Note that each of the above-mentioned editing features can be accessed through one of the numerous summary tables available in MROPS. To do this, bring up the appropriate summary table, click on the name of the item to be edited, and click on the **Edit** button.

3.8.6 Deleting Labels

To delete a label, choose **Delete Label** option from the **Edit** menu. This will display a listing of the labels. Click on the desired label, then click on the **Delete** button. This action will delete the labels.

3.9 Controlling MRNMAP Calculations With the Run Options

It is possible to control certain aspects of the calculations which MRNMAP performs on a given airspace scenario through the **Options** item in the **Run** menu of MROPS. On the left-hand side of the **Run Options** dialog is the **Calculations** box, which contains a list of noise metrics, from which one can be chosen. The list includes the following:

L_{dn}	day-night average sound level
L_{dnmr}	onset rate-adjusted monthly day-night average A-weighted sound level
L_{eq}	energy equivalent sound level
L_{max}	maximum A-weighted sound level
SEL	sound exposure level

To choose one of these, click on the radio button next to the desired metric.

This screen also allows you to limit the MRNMAP's analysis to certain types of airspace. To calculate noise levels only on MOAs and ranges, click on the radio button labeled **MOAs Only**. To calculate noise levels only on MTRs and bombing tracks, click on the radio button labeled **Tracks Only**. The default choice is **All**, which instructs MRNMAP to calculate noise levels on all of the pieces of airspace, regardless of type.

Use the **Event Cutoff** field to specify the SEL sound level below which MRNMAP will ignore individual noise events.

You may also specify the **Standoff Distance** from the **Run Options** dialog. The standoff distance is defined as the distance inward from the edge of a MOA or range where pilots begin to turn to avoid overflying the MOA or range boundary.

The final option available on this dialog is the **Grid** option. Clicking on **No Grid** instructs MRNMAP to calculate noise levels without creating the grid (.GRD) file which is used to display the contours. This option can be used to reduce processing time. Clicking on the **ASCII Grid** option creates an (.) file that contains the noise levels in an ASCII raster text format. This file format is readable by the Geographic Resources Analysis Support System (GRASS).

To accept the run options, click on the **OK** button. To abort and restore the original options, click on the **Cancel** button.

3.10 Running MRNMAP and NMPLOT From MROPS

It is possible to run two other programs from within MROPS: MRNMAP, which calculates the noise levels in the airspace specified by MROPS, and NMPLOT, which displays the noise contours calculated by MRNMAP. To run MRNMAP, choose the **MRNMAP** option under the **Run** menu item. This will bring up the **Run MRNMAP** dialog, which allows you to choose the input file (.INP) you would like MRNMAP to process. The file name will default to the name of the file that is currently loaded into MROPS, or to "*.inp" if no file is currently loaded. Type the name of the desired input file, or click on that file name with the mouse. Click the **OK** button to run MRNMAP with the selected input file, or the **Cancel** button to abort. Note that MRNMAP processes the data in the selected file, regardless of whether any data has been loaded into MROPS. Therefore it is not necessary to load an input file into MROPS before running MRNMAP, but care should be taken to save any changes made to an input file that *is* loaded into MROPS before processing that file with MRNMAP.

To run NMPLOT from within MROPS, choose the **NMPLOT** option from under the **Run** menu item. This will display a dialog box entitled **Run NMPLOT**, which is identical in format and functionality as the one described above. Type in the name of the grid file (.GRD) to be processed by NMPLOT, or choose a file with the mouse, then click the **OK** button. Use the **Cancel** button to abort at any time.

3.11 Standard File Features

The main menu bar contains a **File** menu which controls basic file manipulation. This menu contains the following options:

- **New** – clear MROPS display and memory in preparation for new data
- **Open** – load a previously created airspace scenario (.INP file) into MROPS
- **Save** – save the data in MROPS to a .INP file
- **Save As** – save the data in MROPS to a different .INP file
- **View/Print** – view and/or print a .INP file created by MROPS or a .TXT file created by MRNMAP
- **Summary Info** – display or change the summary informationn (user's name, airspace description, and comments) of the currently loaded file

Print Map – print the airspace map currently loaded into MROPS

Printer Setup – set the printer specifications (type, orientation, paper size)

Exit – quit MROPS

3.12 Solutions to Common Problems

Problems may occur while you are using MROPS. The following is a list of the more common ones, along with possible solutions.

Problem: A MOA or an MTR was loaded into MROPS from one of the airspace databases, but it does not appear on the screen.

Solution:
A. Zoom out. The MOA or MTR may be on a part of the map that is not currently visible.

B. Check the latitude and longitude values under Grid Specifications. If the coordinates of the MOA or MTR are not within the area defined by the Grid Specifications, it will not be seen on the map.

Problem: An Avoidance Area was placed on the map, but only the center point is visible.

Solution: Check the value entered for the radius. If the radius is too large, the boundary of the Avoidance Area will be plotted off the screen.

Problem: An error indicating that the file NOISE was not found occurred while running MRNMAP from MROPS.

Solution: Exit MROPS and exit Windows. Using any commercial editor, add the line **SET NOISE=C:\MRNMAP** to you AUTOEXEC.BAT file and reboot your computer. This will tell MROPS where to look for the NOISE file which is essential to the execution of MRNMAP. Please note, if you did not install MROPS and MRNMAP to the default directory (C:\MRNMAP), substitute the name of your installation directory above.

CHAPTER 4

USING MRNMAP

MRNMAP is the calculating program. It reads an input file that contains the airspace scenario, mission profiles, and operation data. From this file, MRNMAP calculates the noise levels. This chapter describes the structure of the input file and the process by which noise levels are calculated. In Section 4.1, the organization and format of the input file is described. Section 4.2 gives instructions on running MRNMAP. Section 4.3 describes the program organization and the noise models contained in MRNMAP.

4.1 MRNMAP

4.1.1 The Input File

MROPS creates an ASCII file (.INP) to transfer data to MRNMAP. The file is based upon a series of keywords which are used to specify all required data, as well as to control MRNMAP's computational procedures and reporting features. Although knowledge of this file is not necessary for the user to run any of the programs, it is possible to bypass MROPS and create and/or manipulate this file using a text editor.

4.1.2 Keywords

MRNMAP has two kinds of keywords: keywords that are used to enter data into MRNMAP and keywords that control MRNMAP computational features. Eleven keywords are available to input data into MRNMAP. Following is a list of these keywords, each followed by a brief description of its purpose:

AREA SPECIFICATION – Specifies the MOA name, area, floor, and ceiling.

AVOIDANCE AREA – Specifies the name, center coordinates, radius, and ceiling of an Avoidance Area.

IMPORT SEL – Specifies the SEL versus distance values for a specified mission.

LOCATION – Specifies the latitude and longitude coordinates of the lower left and upper right corners of the grid, and the mean ground elevation.

MISSION – Specifies the name, aircraft type, power and speed setting, and the altitude profile for a mission.

MOA OPS – Specifies the numbers of aircraft sorties and the types of missions flown on a MOA or range.

MOA SPECIFICATION – Specifies the name, boundary points, floor, and ceiling of a MOA or range.

SETUP PARAMETER – Specifies the number of MOA's, Ranges, and Tracks, the size of the grid, the temperature, relative humidity, and number of days in a month, and the exceedance cutoff level.

SPECIFIC POINT – Specifies the name of a specific point and its location.

TRACK OPS – Specifies the numbers of aircraft sorties and the type of missions flown on an MTR or a Bombing Track.

TRACK SPECIFICATION – Specifies the name, turn points, route width, floor, and ceiling of an MTR or Bombing Track.

The second group of keywords controls the computational and reporting features of MRNMAP. The following is a list of these keywords, each followed by a brief description of its purpose:

CNEL – Sets the output noise metric to Community Noise Equivalent Level.

LDN – Sets the output noise metric to A-weighted day-night average sound level.

LDNMR – Sets the output noise metric to onset rate-adjusted monthly day-night average A-weighted sound level.

LEQ – Sets the output noise metric to Equivalent Sound Level.

LMAX – Sets the output noise metric to Maximum A-weighted Sound Level.

SEL – Sets the output noise metric to Sound Exposure Level.

SELR – Sets the output noise metric to onset rate-adjusted Sound Exposure Level.

TAPER 0 – Specifies a standoff distance of 0 nautical mile.

TAPER 1 – Specifies a standoff distance of 1 nautical mile.

TAPER 2 – Specifies a standoff distance of 2 nautical miles.

TAPER 5 – Specifies a standoff distance of 5 nautical miles.

DIAGNOSTICS – Outputs an extensive number of internal diagnostic comments.

ONLY MOA – Limits noise level calculations to MOAs and ranges only.

ONLY TRACK – Limits noise level calculations to MTRs and Bombing Tracks only.

ASCII GRID – Outputs on ASCII grid file ready for inclusion into the Geographical Resources Analysis Support System (GRASS).

NO GRID – Limits MRNMAP output to a .TXT file only.

There are three additional keywords available in the input file:

COMMENT or **REM** – Marks a comment line.

END – Marks the end of the file. Lines after this will not be processed by MRNMAP.

See Appendix A for the specific format of each of the keywords.

4.1.3 Organization

4.1.3.1 *Data Entry Keywords*

The organization of an input file is very similiar to the steps followed when collecting operations data for an airspace analysis. The process of collecting operations data and entering the data into the input file is described in this section. Only the more experienced user should attempt editing the input file. For detailed instructions on the file format and syntax, see Appendix A.

The first step in collecting operations data is locating the airspace on the aeronautical charts and determining its geographical coordinates. Entering airspace boundaries into MRNMAP is done using the SETUP PARAMETER and LOCATION, the MOA SPECIFICATION, and the TRACK SPECIFICATION keywords. The SETUP PARAMETER keyword appears first in the input file. This keyword specifies the grid dimensions and the spacing between grid points. MOA SPECIFICATION AND TRACK SPECIFICATION are the two keywords used to enter MOA, range, and track coordinates. These two keywords are usually found near the beginning of the input file, following the SETUP PARAMETER keyword.

The second step in the data collection process is identifying the types of aircraft that use the airspace and their mission profiles. This information is entered into the input file using the MISSION keyword. Under this keyword the user supplies the aircraft type, the power and speed setting, and the altitude profile. Often an airspace scenario will require several MISSION keywords, since one MISSION keyword is required for each aircraft type and altitude profile.

The final step in collecting operations data is determining the number of operations flown in each airspace. Specifying the operations is done in the input file using the MOA OPS and TRACK OPS keywords. Under these operation keywords appear the names of the airspace and missions. These names of airspace components and misssions are used when assigning the operations and may only be used after they have been defined under the MOA SPEC, TRACK SPEC, and MISSION keywords.

The END keyword follows the MOA OPS and TRACK OPS keywords. This keyword signals the end of the operation data and causes MRNMAP to stop reading the input file. Data that follows the END keyword is used by MROPS to draw the screen graphics and record editorial features. Never attempt to edit this data without using MROPS.

4.1.3.2 *Control and Reporting Keywords*

The keywords shown in Section 4.1.2 make it possible to control the calculations which MRNMAP performs for a given airspace scenario. To use these keywords, the keyword name is entered into the input file; no other data is required. The keyword can be freely inserted anywhere in the file.

The control and reporting keywords are divided into three main groups: the first group specifies the noise metric, the second group specifies the model for tapering aircraft operations near a MOA edge, and the third group is used for limiting the calculations performed, which can be helpful for locating errors in the input file. These keywords are organized as follows.

Noise Metrics – CNEL, CNELR, LDN, LDNMR, LEQ, LMAX, SEL, and SELR.
MOA edge model – TAPER 0, TAPER 1, TAPER 2, and TAPER 5.
Program Control – DIAGNOSTICS, ONLY MOA, ONLY TRACK, ASCII GRID, NO GRID, and END.

The noise metric keywords specify which one of eight possible noise metrics MRNMAP is to calculate. Only one metric can be calculated at a time. When more than one metric is required, MRNMAP must be executed once for each noise metric. To calculate a noise metric, simply insert the appropriate keyword into the input file. If MROPS is used to create the input file, these options can be chosen from the **Run Options** dialog which is accessed through the **Options...** item in the **Run** menu. If none of these keyword names appears in the input file, MRNMAP will default to onset rate-adjusted day-night average A-weighted sound level (L_{dnmr}).

The MOA edge model keywords specify the procedure for tapering operations near a MOA edge. The noise models contained in MRNMAP assume operations in MOAs and ranges are uniformly distributed. Near a MOA edge, where the operations are expected to drop off, experimental studies have shown that the number of operations decrease linearly as the MOA edge is approached. The distance from the MOA edge where the transition from a uniform distributed level of operations to a decreasing level of operations begins is called, in this document, the standoff distance. Figure 4-1 shows a sketch of the MOA edge. The standoff distance will vary depending on the MOA size, shape, and purpose. For example, small MOAs having a large number of operations will have a small standoff distance. The user has the choice of four standoff distance values varying between zero and five nautical miles. For most situations, the user will choose a standoff distance of 1 nm (TAPER 1) or 2 nm (TAPER 2). If no standoff distance is specified in the input file, MRNMAP will assume a distance of 0 nm.

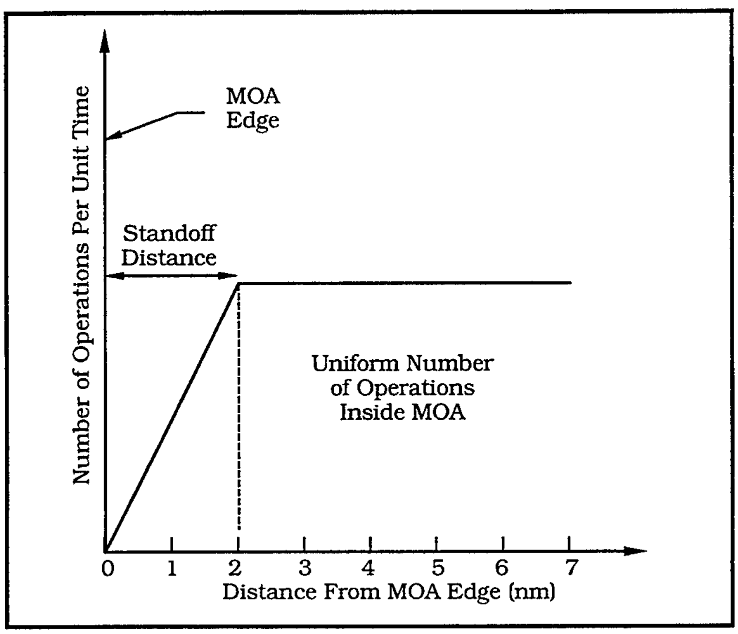


Figure 4-1. MOA Edge Model.

The reporting keywords are used to locate errors in the input file. Creating or manipulating the input file using a text editor is the most frequent cause of errors. When MRNMAP detects an error, one of the following two error messages will appear at the bottom of the FILENAME.TXT file:

*** READ ERROR FROM MR NMAP ***

or

*** ERROR IN SUBROUTINE blank ***

In the latter case, blank is replaced with the name of the subroutine.

Read errors occur at the beginning of the program when MRNMAP is reading the input file and checking its syntax. The "ERROR IN SUBROUTINE ____" message occurs when an error, originating from the input file, is discovered during the calculations.

Following is a list of instructions on using the program control keywords when an error is found.

1. Add a DIAGNOSTIC keyword to the input file. This keyword will cause MRNMAP to report intermediate values.
2. Move the END keyword to other positions in the input file. This will cause MRNMAP to abruptly terminate and output a text file that echoes the input data read thus far.
3. Add an ONLY MOA keyword. This will disable the track algorithms in MRNMAP. If the program runs successfully, the error is located in the track section of the input file.
4. Add a ONLY TRACK keyword. This will disable the MOA algorithms in MRNMAP. If the program runs successfully, the error is located in the MOA section of the input file.
5. Add a NO GRID keyword. If the program runs successfully, the problem is located in the grid specifications.

4.1.3.3 Ordering of Keywords

Although there is no exact order for the keywords, certain rules must be followed when creating or editing a MRNMAP input file without MROPS. These are:

1. The SETUP PARAMETERS keyword must appear before any other *data specification* keyword.
2. The LOCATION keyword must appear directly after the SETUP PARAMETERS keyword.
3. An IMPORT SEL keyword must appear after the MISSION keyword that it references.
4. A MOA OPERATIONS keyword must appear after any MOA SPECIFICATION or MISSION keywords that it references.
5. A TRACK OPERATIONS keyword must appear after any TRACK SPECIFICATION or MISSION keywords that it references.
6. All data specification keywords, computational control keywords, and reporting feature keywords must appear before the END keyword.

Figure 4-2 is an example of an input file which follows the above rules and guidelines. Although not required, it is suggested that the MOA and TRACK SPECIFICATION keywords be placed directly after the LOCATION keyword. These should then be followed by the MISSION keywords, and then the MOA and TRACK OPERATIONS keywords.

4.2 Running MRNMAP

Once an input file is available for processing, MRNMAP can be run in one of three ways. The first, as discussed in Section 3.10, is through the **MRNMAP** option in the **Run** menu of MROPS. Enter the name of the input file to be processed in the **File Name** field, or choose the input file from the list of files displayed, and click **OK**. A window will appear with the title "MRNMAPX – [Calculating noise levels for filename.inp]". This window will close when processing is complete.

The second is to run MRNMAP from Windows without the use of MROPS. To do this, choose the **Run** option from the Windows **File** menu. If the NOISE environment variable has been set up (see Section 1.4, Installation), simply type

```
                    SETUP PARAMETERS
                    1           0
SETUP               4895
PARAMETERS          1023952     11796792
                    1640417     12177374
                    59          70          30
                    65
                    LOCATION
                    032d30'00.0000"N    083d00'00.0000"W
                    033d30'00.0000"N    081d00'00.0000"W
                    0
                    MOA SPECIFICATION
                    BULLDOG A
                    8
                    1065578     11990057
AIRSPACE            1182032     12066868
SPECIFICATIONS      1217714     12054479
                    1289072     12059433
                    1311372     12015329
                    1328219     11919690
                    1107206     11848824
                    1065578     11990057
                    500         10000
                    MISSION
MISSION             F-16
SPECIFICATIONS      127         500         84
                    1
                    500         500         100
                    MOA OPS
                    1
OPERATIONS          BULLDOG A                           100
                    1
                    F-16        2500        0           1000        30
FEATURE             LDN
CONTROLS            TAPER 2
                    END
                    LABELS
                    1
                    BULLDOG A, 0
                    362852,3632071
                    USER INFO
                    ALPHA TESTER
                           BULLDOG AREA
                    BULLDOG A MOA
                    COORDINATES
                    BULLDOG A
                    033:01:01N,082:52:30W
                    033:14:01N,082:29:59W
                    033:12:01N,082:22:59W
                    033:13:01N,082:08:59W
                    033:05:46N,082:04:29W
                    032:50:01N,082:00:59W
                    032:37:51N,082:43:59W
                    500         ,10000
```

Figure 4-2. MR_NMAP Input File SAMPLE1.INP.

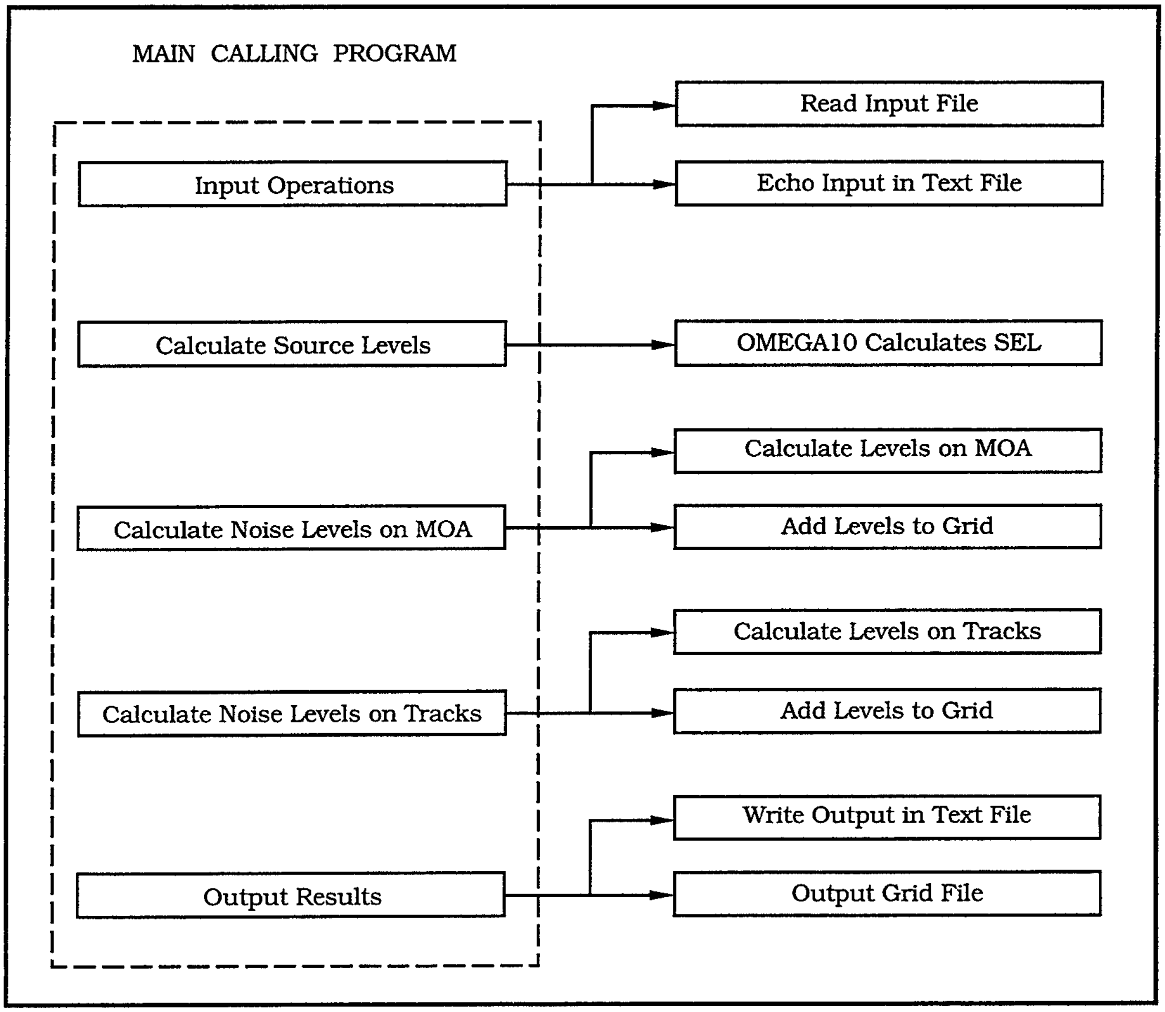


Figure 4-3. Program Organization.

"mrnmapx" followed by the path and name of the input file in the **Command Line** field and click **OK**. If the NOISE environment variable has not been set up, prepend "mrnmapx" with its path. This method will also bring up the MRNMAPX window, which will close when the processing if the input file is complete.

The third way is to run MRNMAP from DOS. To get to a DOS prompt, either exit Windows, or choose the MS-DOS Prompt icon in the Main Windows program group. Change to the MRNMAP\DOSVER directory, and type "MRNMAP" followed by the name of the input file to be processed. Be sure to include the path of the input file with the file name if it is not in the same directory. The output files (filename.INP and filename.GRD) will be created in the directory where the input file is located.

MRNMAP requires access to a file called "NOISE". When MRNMAP is unable to find the NOISE file, the message "ERROR READING NOISE DATA FILE" appears on the screen. If this error should occur, use an editor to add the line SET NOISE=C:\MRNMAP to the AUTOEXEC.BAT file and reboot the computer. This command tells MRNMAP where the NOISE file is located.

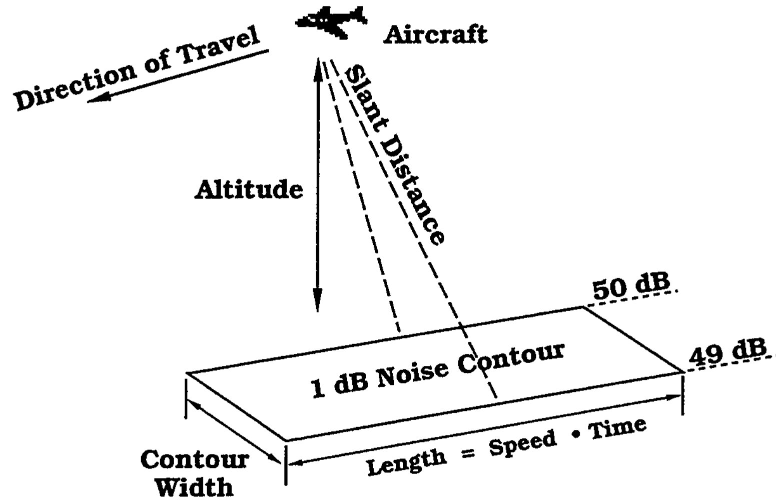
4.3 Noise Models

4.3.1 Overview

MRNMAP's organization is shown in Figure 4-3. The arrows indicate the order of access to the various routines and the overall flow of the program. This section provides an overview on the program's organization and computational procedures. Details of the noise models are discussed in subsequent sections.

The program begins with MRNMAP reading the input file, and checking the file for data and syntax errors. When an error is detected, the program will display the message "Process Stopped" and write an error message followed by a line number at the bottom of the text (.TXT) file. The line number points to the line in the input file that generated the error. Use DOS Edit to locate the line in the input file. When no errors are detected, MRNMAP echoes the input to the .TXT file.

Next, MRNMAP calculates the SEL values using the Air Force NOISEFILE acoustical data set. NOISEFILE contains measured one-third octave band data sets from controlled flyovers at prescribed power and speed settings. MRNMAP calls a



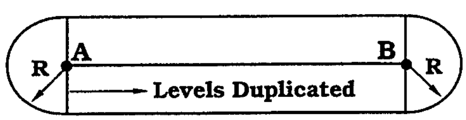
$$\text{TOTAL LEVEL} = \sum_{\substack{\text{All} \\ \text{Contours}}} \frac{\text{Current Level } [2\,(\text{Contour Width})\,(\text{Length})\,]}{\text{Total MOA Area}}$$

Figure 4-4. Algorithm Used to Calculate Noise From Distributed Operations.

1. One Single Dominant Track.

NoiseMap Approach

2. Distributed Operations on a Track.
a. Constant Altitude Between Points A and B.
b. Constant Standard Deviation Between Points A and B.



Computes Look-Up Table, Then Duplicates Levels Along Track.

3. Distributed Operations on a Track. Either the Altitude or Standard Deviation Vary Linearly Between Points A and B.

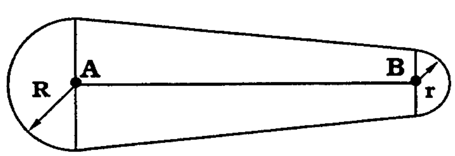


Figure 4-5. Algorithms Used to Calculated Noise From Operations on a Track.

subroutine version of the OMEGA10 program, which reads the NOISEFILE data set and calculates the SEL levels for the specified aircraft settings. These levels are returned to MRNMAP and used in all future noise calculations.

If a new aircraft has been added to the DOD inventory for which there are no NOISEFILE sets, the program will read the SEL values directly from the input file, provided they are entered at the same slant distances used in OMEGA10. A discussion on importing SEL values directly is found in Appendix A under the IMPORT SEL keyword.

Once the SEL values have been determined, MRNMAP calculates the noise due to distributed aircraft operations. The program first constructs a table of SEL versus ground distance based on the aircraft operating at an equivalent acoustical altitude (defined in Section 4.3.2). Then the distance separating noise contours, determined from the table, is multiplied by time spent in the airspace and the actual speed of the aircraft. The result is the area of the noise contours swept out under the airspace. The energy-average is calculated by normalizing this area with respect to the total airspace area and summing over all contours (see Figure 4-4). At the edges of the airspace, where operations end, the noise is calculated using a model that tapers the number of operations. Details of this model are described in Section 4.3.3. The model is based on measurements made in actual MOAs and aircraft trajectory data collected from aircraft training in MOAs and ranges.

Next, MRNMAP calculates the noise levels under the tracks. The track algorithms in MRNMAP closely approximate those algorithms in the USAF NOISEMAP and ROUTEMAP computer programs. MRNMAP models three track scenarios: tracks that follow a single dominate track, tracks that are distributed as a Gaussian distribution of line sources having the same standard deviation and altitude at either end of the line segment, and tracks that are distributed as a Gaussian distribution of line segments having a standard deviation and altitude that are not the same at either end of the line segment (see Figure 4-5). Turns are modeled as connecting line segments using algorithms similar to the ones used in the FAA's Integrated Noise Model (INM).[5]

Following the noise calculations, MRNMAP outputs a summary of the noise levels for the MOAs, Ranges, and tracks to the text file. Included in the text file are the noise levels and the number of events over a prespecified level for each airspace component. Reporting the number of events over a prespecified level is not part of quantitative impact analysis, but is very useful when describing the noise environment to community planners and the general public.

The last step is writing a binary grid file containing the noise levels. The file is read by NMPLOT when displaying the noise contours.

4.3.2 Equivalent Acoustical Altitude

Equivalent acoustical altitude (EAA) is the constant altitude at which an aircraft must fly to produce the same noise level for a distributed altitude profile. Using the EAA in place of the altitude profile in the noise calculations significantly increases the computational speed by reducing the number of calculations MRNMAP makes.

Calculating the EAA in MRNMAP is done as a two-step process. The first step sums the noise level directly under the aircraft using the altitude distribution appearing under the MISSION keyword. The summing process begins at the floor of the airspace and continues up to the ceiling. The result is the total noise level under the aircraft. In the second step, the program uses this noise level to look up the equivalent altitude from the SEL tables. This becomes the equivalent acoustical altitude and its value replaces the altitude distribution in subsequent calculations.

As a general rule, when the altitude distribution is below the floor of the airspace, the equivalent acoustical altitude is set equal to the airspace floor. For example, suppose the altitude distribution under a MISSION keyword has all the operations assigned between 50 and 100 feet AGL, and the floor of a track segment is 500 feet AGL. The equivalent acoustical altitude is then calculated to be equal to 500 feet AGL. This rule applies for MOAs, Ranges, Tracks, and MTRs.

4.3.3 MOA Edge Model

Noise modeling in MOAs and ranges assumes the operations are uniformly distributed. Near the MOA edges, examination of radar track data has shown that the operations decrease at a linear rate. The noise level near the MOA edges is calculated using the following formulation:

$$\text{Grid Point Level} = \text{Energy Average Level} + 10\log_{10}(d/S)$$

where d is the distance from the grid point to the MOA edge and S is the standoff distance (see Figure 4-1). The energy-average level is the level calculated assuming all the operations are uniformly distributed. This formulation has the effect of lowering the noise levels at the MOA edges thus reducing the total acoustical energy. To preserve the total acoustical energy an adjustment is made to all the grid points contained within the MOA so that the total noise level equals the noise level calculated assuming uniformly distributed operations.

4.3.4 Avoidance Area Model

When a MOA/range and an avoidance area intersect, MRNMAP sets the MOA floor equal to the avoidance area ceiling and recalculates the equivalent acoustical altitude using the new value for the MOA floor. The equivalent acoustical altitude calculations follow the same rules as before, with the exception that the avoidance area ceiling is now the MOA floor. If the altitude profile is below the avoidance area ceiling, the equivalent altitude is equal to the avoidance area ceiling. Operations no longer fly through the avoidance area, but rather fly above it at an altitude equal to the avoidance area ceiling.

4.3.5 Track Models

Distributed operations on a track are modeled as a Gaussian distribution of line sources. The standard deviation for the Gaussian distribution can be supplied directly by the user or calculated given the route width. When the route width is specified, the program calculates the standard deviation by multiplying the total width by 0.17. If the resulting standard deviation is less than 1 nm, the standard deviation is set equal to 1 nm (see Reference 6).

In MRNMAP, track operations are modeled as a single dominate line source when the user supplies a route width less than 1 nm or a standard deviation less than 0.5 nm. When the operations are distributed, MRNMAP uses the same algorithms contained in ROUTEMAP. If the operations follow a single track, MRNMAP uses the algorithms identical to those found in NOISEMAP. Choosing a route width less than 1 nm or a standard deviation less than 0.5 nm effectively switches noise models in MRNMAP.

Circular ground tracks or turns are modeled in MRNMAP as an even number of connecting line segments. The segments length is selected so that the subtended angle of a segment is no greater than 30 degrees. Finite length approximations are made on all line segments using the same algorithms contained in NOISEMAP.

Consider the situation on a track where the aircraft altitude changes from one segment to the next. This situation is modeled in MRNMAP by defining an altitude profile, under the MISSION keyword, that has all the operations less than or equal to the altitude of the lowest track segment. When MRNMAP calculates the equivalent acoustical altitude, the altitude profile which is below the floor of the airspace will cause MRNMAP to set the equivalent acoustical altitude equal to the airspace floor (see Section 4.3.2).

REFERENCES

1. Wyle Research Staff, "Noise Impact of Military Training Routes, Preliminary Considerations", Wyle Research Technical Note TN 85-12, December 1985.

2. Plotkin, K.J., *et al.*, "The Effect of Onset Rate on Aircraft Noise Annoyance. Vol. 1: Laboratory Experiments", Wyle Research Report WR 91-19, November 1991.

3. Stusnick, E., *et al.*, "The Effect of Onset Rate on Aircraft Noise Annoyance. Vol. 2: Rented Home Experiment", Wyle Research Report WR 92-3(4), March 1992.

4. Stusnick, E., *et al.*, "The Effect of Onset Rate on Aircraft Noise Annoyance. Vol. 3: Hybrid Own-Home Experiment", Wyle Research Report WR 93-22, December 1993.

5. Flythe, M.C., "INM, Integrated Noise Model, Version 3, User's Guide – Revision 1", Federal Aviation Administration, DOT/FAA/EE-92/02, June 1992.

6. Frampton, K.D., Bradley, K.A., and Plotkin, K.J., "The Distribution of Flight Tracks Across TAC VFR Military Training Routes", Wyle Research Report WR 92-10, May 1992.

APPENDIX A

Keyword Format

This appendix specifies the keyword syntax and describes the procedure for editing the input file. It is not essential to understand the keyword syntax to run MRNMAP. These instructions are provided for users that prefer to edit the file directly rather than use the edit capabilities in MROPS. Keywords are organized in alphabetic order; each keyword name is followed by a description on the keyword usage and a table showing its format.

When MRNMAP reads the input file, certain assumptions are made about the data. These assumptions are as follows:

1. All numeric data is interpreted as an integer number.
2. All lowercase characters are interpreted as uppercase characters.
3. All length dimensions are in units of feet.
4. Altitude is in units of feet above ground level (AGL).
5. A mission name may only be used once under the MISSION keyword.
6. An airspace name may only be used once under the MOA and TRACK SPECIFICATION keywords.

Editing or creating an input file outside of MROPS can introduce errors. MRNMAP has error-checking features that identify most of the common errors users make. Sometimes, however, an error will evade MRNMAP error checking features, causing the program to terminate unexpectedly. See Section 4.1.3.2, Control and Reporting Keywords, for hints on finding and resolving input file errors.

Keyword **AREA SPEC**

AREA SPEC specifies the MOA area, floor, and ceiling. The maximum number of AREA SPEC plus MOA SPEC keywords permitted in the input file is 25. This keyword is not available from MROPS. Shown in Table A-1 is the keyword format.

Table A-1

AREA SPEC Keyword Format

Line No.	Columns 1-10	Columns 11-20
1	Name of the MOA Maximum of 25 Characters	
2	MOA Area in Square Feet	
3	Floor of MOA in feet AGL	Ceiling of MOA in feet AGL

Keyword **AVOIDANCE**

AVOIDANCE specifies the center, radius, and ceiling of an avoidance area. The maximum number of AVOIDANCE keywords permitted in the input file is 25. Shown in Table A-2 is the keyword format.

Table A-2

AVOIDANCE Area KeywordFormat
(N = Number of avoidance areas)

Line Number	Columns 1-10	Columns 11-20	Columns 21-30	Columns 31-40	Columns 41-50	Columns 51-60
1	Number of Avoidance Areas					
2 ⋮	Name of Avoidance Area Maximum of 20 Characters		X-Coordinate	Y-Coordinate	Radius in Feet	Ceiling in Feet AGL
N+1	Name of Avoidance Area Maximum of 20 Characters		X-Coordinate	Y-Coordinate	Radius in Feet	Ceiling in Feet AGL

Keyword **IMPORT SEL**

IMPORT SEL specifies the noise level versus distance relationship. This keyword is used in place of the NOISEFILE acoustical data set. To activate this option enter an ID Code of 999 under the MISSION keyword and be sure to use the same mission name under the MISSION keyword as appears under the IMPORT SEL keyword. The IMPORT SEL keyword must appear after the MISSION keyword that it references. The maximum number of IMPORT SEL keywords is 50. This keyword is not available from MROPS. Shown in Table A-3 is the keyword format.

Table A-3

IMPORT SEL Keyword Format

Line Number	Columns 1-10	Columns 11-20	Columns 21-30	Columns 31-40	Columns 41-50
1	Mission Name 10 Characters				
2	Air to Ground at 100 feet	Air to Ground at 125 feet	Air to Ground at 160 feet	Air to Ground at 200 feet	Air to Ground at 250 feet
3	Air to Ground at 314 feet	Air to Ground at 400 feet	Air to Ground at 500 feet	Air to Ground at 630 feet	Air to Ground at 800 feet
4	Air to Ground at 1,000 feet	Air to Ground at 1,250 feet	Air to Ground at 1,600 feet	Air to Ground at 2,000 feet	Air to Groun dat 2,500 feet
5	Air to Ground at 3,150 feet	Air to Ground at 4,000 feet	Air to Ground at 5,000 feet	Air to Ground at 6,300 feet	Air to Ground at 8,000 feet
6	Air to Ground at 10,000 feet	Air to Ground at 12,500 feet	Air to Ground at 16,000 feet	Air to Ground at 20,000 feet	Air to Ground at 25,000 feet
7	Grnd to Grnd at 100 feet	Grnd to Grnd at 125 feet	Grnd to Grnd at 160 feet	Grnd to Grnd at 200 feet	Grnd to Grnd at 250 feet
8	Grnd to Grnd at 100 feet	Grnd to Grnd at 125 feet	Grnd to Grnd at 160 feet	Grnd to Grnd at 200 feet	Grnd to Grnd at 250 feet
9	Grnd to Grnd at 1,000 feet	Grnd to Grnd at 1,250 feet	Grnd to Grnd at 1,600 feet	Grnd to Grnd at 2,000 feet	Grnd to Grnd at 2,500 feet
10	Grnd to Grnd at 3,150 feet	Grnd to Grnd at 4,000 feet	Grnd to Grnd at 5,000 feet	Grnd to Grnd at 6,300 feet	Grnd to Grnd at 8,000 feet
11	Grnd to Grnd at 10,000 feet	Grnd to Grnd at 12,500 feet	Grnd to Grnd at 16,000 feet	Grnd to Grnd at 20,000 feet	Grnd to Grnd at 25,000 feet

Keyword **LOCATION**

LOCATION specifies the lower left and upper right corners of the grid in world coordinates. The ground elevation converts the MSL altitudes supplied in the FAA MTR database to AGL. This keyword is required by MROPS to draw the screen graphics. The LOCATION keyword is not necessary if the user plans to run MRNMAP without the use of MROPS. Shown in Table A-4 is the keyword format.

Table A-4

LOCATION Keyword Format

USAGE:

Line No.	Columns 1-10	Columns 11-20	Columns 21-30	Columns 31-40
1	Latitude Lower Left Corner		Longitude Lower Left Corner	
2	Latitude Upper Right Corner		Longitude Upper Right Corner	
3	Ground Elevation in feet AGL			

Keyword **MISSION**

MISSION specifies the aircraft mission profile. The elements of a mission profile are the aircraft ID code, the power and speed setting, and the altitude profile. The aircraft ID codes and the default power and speed settings are shown in Appendix B.

The altitude profile is entered in terms of a lower and upper altitude pair. Appearing beside each altitude pair is the percent time or time in minutes the aircraft spends between the two altitude limits. A maximum of ten altitude pairs can be entered for each mission. The altitude profile must begin at the lowest altitude and be contiguous from one altitude pair to the next. Consider the profile shown in Table A-5.

Table A-5

Example Altitude Profile Specified as Percent Time

Lower Altitude Feet AGL	**Upper Altitude Feet AGL**	**Percent Time**
100	250	30
250	500	40
500	1000	30

Suppose the total sortie time is 30 minutes; then an equivalent profile is shown in Table A-6.

Table A-6

Example Altitude Profile Specified in Absolute Units of Time.

Lower Altitude Feet AGL	**Upper Altitude Feet AGL**	**Time in Minutes**
100	250	9
250	500	12
500	1000	9

Both profiles will produce the same noise levels, since MRNMAP calculates the weighted average, and does not use the percentages or times directly. Shown in Table A-7 is the keyword format. The maximum number of MISSION keywords is 50.

Table A-7

MISSION Keyword Format
(N = Number of Altitude Pairs)

Line Number	Columns 1–10	Columns 11–20	Columns 21—30
1	Mission Name Max. of 10 Char.		
2	Aircraft ID Code	Speed Setting	Power Setting
3	Number of Altitude Pairs		
4 ⋮	Lower Altitude Limit in Feet AGL	Upper Altitude Limit in Feet AGL	Percent Time or Time in Minutes
N+3	Lower Altitude Limit in Feet AGL	Upper Altitude Limit in Feet AGL	Percent Time or Time in Minutes

Keyword **MOA OPS**

MOA OPS specifies the number of operations in each MOA. The keyword has two parts. The first part lists the MOAs and/or ranges and the percent utilization. The second part lists the mission names and the annual operations. MRNMAP multiples the annual operations by the percent utilization when calculating the number of operations assigned to the individual MOAs. The "Minutes in Airspace" is not multiplied by the percent utilization. Day, evening, and night operations assume 0700 through 2200 to be daytime and 2200 through 0700 to be nighttime for DNL calculations, and 0700 through 1900 to be daytime, 1900 through 2200 to be evening, and 2200 to 0700 to be nighttime for CNEL calculations. If the noise metric is CNEL, evening operations must be entered using a text editor. Shown in Table A-8 is the keyword format.

Table A-8

MOA OPS keyword format
(M = Number of MOAs and N = Number of missions)

Line No.	Columns 1–10	Columns 11–20	Columns 21–30	Columns 31–40	Columns 41–50
1	Number of MOAs				
2 ⋮	Name of the MOA Maximum of 25 Characters			Percent Utilization of Operations	
M+1	Name of the MOA Maximum of 25 Characters			Percent Utilization of Operations	
M+2	Number of Missions				
M+3 ⋮	Name of the Mission	Number of Annual Day Operations	Number of Annual Evening Operations	Number of Annual Night Operations	Minutes in the Airspace
M+N+2	Name of the Mission	Number of Annual Day Operations	Number of Annual Evening Operations	Number of Annual Night Operations	Minutes in the Airspace

Keyword **MOA SPEC**

MOA SPEC specifies the airspace boundaries. The boundary points can be entered clockwise or counterclockwise. Connecting line segments cannot cross. Shown in Table A-9 is the keyword format. The maximum number of MOA SPEC and AREA SPEC keywords is 25 and the maximum number of points defining a MOA boundary is 25. The last boundary point must be the same as the first for closure of the airspace.

Table A-9

MOA SPEC Keyword Format
(N = Number of Points Defining MOA Boundary)

Line No.	Columns 1–10	Columns 11–20	Columns 21–30
1	Name of the MOA Maximum of 25 Characters		
2	Number of points defining MOA Boundary.		
3	X-Coordinate for First Point	Y-Coordinate for First Point	
4 ⋮	X-Coordinate for Second Point	Y-Coordinate for Second Point	
N+2	X-Coordinate for N'th Point	Y-Coordinate for N'th Point	
N+3	Floor of MOA in feet AGL	Ceiling of MOA in feet AGL	

Keyword **SPECIFIC POINT**

SPECIFIC POINT specifies the X and Y location for specific points at which noise levels are to be calculated. Shown in Table A-10 is the keyword format. The maximum number of SPECIFIC POINT keywords is 25. This keyword is not available from MROPS.

Table A-10

SPECIFIC POINT Keyword Format
(N = Number of Specific Points)

Line Number	**Columns 1–10**	**Columns 11–20**	**Columns 21–30**	**Columns 31–40**
1	Number of Specific Points			
2 ⋮	Name of Specific Point Maximum of 20 Characters		X-Coordinate	Y-Coordinate
N+1	Name of Specific Point Maximum of 20 Characters		X-Coordinate	Y-Coordinate

Keyword **SETUP PARA**

SETUP PARA specifies basic grid and airspace parameters. SETUP PARA must appear at the very beginning of the input file. When MROPS is used to create the input file, the X and Y values for the two grid corners are in UTM coordinates which have been converted to units of feet. Shown in Table A-11 is the keyword format.

Table A-11

SETUP PARA Keyword Format

Line Number	**Columns 1–10**	**Columns 11–20**	**Columns 21–30**
1	Number of MOAs	Number of Tracks	
2	Grid Point Spacing in feet		
3	X-Coordinate Lower Left Corner of Grid	Y-Coordinate Lower Left Corner of Grid	
4	X-Coordinate Upper Right Corner of Grid	Y-Coordinate Upper Right Corner of Grid	
5	Air Temperature in Degrees Fahrenheit Sug. Val. 59°F	Percent Relative Humidity Suggested Value 70%	Number of Days in a Month Suggested Value 30
6	Number of Events Cutoff Level Suggested Value 65 dB		

Keyword **TRACK OPS**

TRACK OPS specifies the number of operations on each track. The keyword has two parts. The first part lists the tracks and the percent utilization. The second part lists the names of the associated missions and the number of annual operations. The program multiplies the mission annual operations by the percentages when calculating the number of operations assign to the individual tracks. The keyword is very similar to MOA OPS with the exception that the minutes in airspace are not required for tracks. Shown in Table A-12 is the keyword format.

Table A-12

TRACK OPS Keyword Format
(M = Number of Tracks and N = Number of Missions)

USAGE:

Line Number	**Columns 1–10**	**Columns 11–20**	**Columns 21–30**	**Columns 31–40**
1	Number of Tracks			
2 ⋮	Name of the Track Maximum of 20 Characters			Percent Utilization of Operations
M+1	Name of the Track Maximum of 20 Characters			Percent Utilization of Operations
M+2	Number of Missions			
M+3	Name of the Mission	Number of Annual Day Operations	Number of Annual Evening Operations	Number of Annual Night Operations
M+N+2	Name of the Mission	Number of Annual Day Operations	Number of Annual Evening Operations	Number of Annual Night Operations

Keyword **TRACK SPEC**

TRACK SPEC specifies the flight track coordinates. As input the keyword requires the X and Y coordinates, the lateral dispersion, and the floor. When the track has a turn segment, the data input includes the turn radius, the change in heading in degrees, and the floor at the turn entry and exit points.

A turn point is defined in this document as the starting point of each line segment. Each turn point occupies a single line of data. Two flags appear at the beginning of each line. These flags signal the line type to MRNMAP. Shown in Table A-13 is a summary of the flags.

Table A-13

Flags Used by MRNMAP to Denote the Line Type

Flag Appearing in Column 1	Flag Appearing in Column 2	Meaning
L	W	Straight line segment. Left and right width supplied.
L	S	Straight line segment. Standard deviation supplied.
T	W	Turning segment. Left and right width supplied.
T	S	Turning line segment. Standard deviation supplied.
N	W	Straight line segment. Standard deviation or altitude are NOT the same at the two ends. Left and right width supplied.
N	S	Straight line segment. Standard deviation or altitude are NOT the same at the two ends. Standard deviation supplied.

Adjacent to the flags are numeric data that specify the other track attributes at each turn point. This data is dependent on the choice of flags used in Table A-13. Shown in Table A-14 are the data structures for the six possible turn point combinations. In this table all dimensions are in feet and the turn angle is in degrees. A positive sign will be used to denote a right-hand turn and a negative sign indicates a left-hand turn.

Table A-14

Input Data Syntax Used to Define a Line Segment

Col. 1–2	Column 11–20	Column 21–30	Column 31–40	Column 41–50	Column 51–60	Column 61–70	Column 71–80	Column 81–90
LW	X-Coor	Y-Coor	Left Width	Right Width	Floor			
LS	X-Coor	Y-Coor	Standard Deviation		Floor			
TW	X-Coor	Y-Coor	Left Width	Right Width	Floor Turn Entry	Floor Turn Exit	Turn Radius	Turn Angle
TS	X-Coor	Y-Coor	Standard Deviation		Floor Turn Entry	Floor Turn Exit	Turn Radius	Turn Angle
NW	X-Coor	Y-Coor	Left Width	Right Width	Floor			
NS	X-Coor	Y-Coor	Standard Deviation		Floor			

Shown in Table A-15 is the keyword format. The turn points, beginning at line 3 and continuing on, follow the format shown in Table A-14. The number of turn points is always one more than the number of line segments. In the table below, N corresponds to the number of turn points and N-1 equals the number of connecting line segments. The maximum number of TRACK SPEC keywords is 25 and the maximum number of turn points per track is 50.

Table A-15

TRACK SPEC Keyword Format
(N = Number of turn points)

Line Number	**Columns 1–10**	**Columns 11–20**	**Columns 21–90**
1	Name of Track Maximum of 20 Characters		
2	Number of Turn Points		
3	First Turn Point		
4 ⋮	Second Turn Point		
N+2	N'th Turn Point		

APPENDIX B

Aircraft Identification Codes

As discussed in Appendix A, the MISSION keyword used to specify an aircraft's mission profile in a MR_NMAP input file requires an aircraft identification code, speed, and power setting. These data are stored in a file named AIRCRAFT.DAT, which is located in the main MR_NMAP directory. This file was created by processing the NOISE acoustical dataset file with a program called CODE.EXE., which is also located in the main directory. If and when the NOISE file is updated, an updated version of the AIRCRAFT.DAT file can be created by typing CODE at the DOS prompt in the appropriate directory. CODE.EXE and NOISE must be in the same directory for this to work. CODE.EXE will automatically overwrite the old version of AIRCRAFT.DAT.

The following is a listing of the AIRCRAFT.DAT file (current as of Sept. 1994).

ID	TYPE	DESCRIPTION	POWER	SPEED (KTS)
001	A-4C	TAKEOFF POWER	100% NC	250
002	A-4C	CRUISE POWER	83% NC	300
003	A-4C	APPROACH POWER	93% NC	150
004	A-5C	AFTERBURNER POWER	100% RPM	250
005	A-5C	TAKEOFF POWER	100% RPM	249
006	A-5C	APPROACH POWER	83% RPM	160
007	A-6A	TAKEOFF POWER	100% RPM	250
008	A-6A	APPROACH POWER	95% RPM	160
009	A-7E	TAKEOFF POWER	96% NC	300
010	A-7E	CRUISE POWER	85% NC	301
011	A-7E	APPROACH POWER	82% NC	160
012	AV-8A	TAKEOFF POWER	103.5% RPM	300
013	AV-8A	CRUISE POWER	75% RPM	350
014	AV-8A	APPROACH POWER	70% RPM	150
015	AV-8B	TAKEOFF POWER	95% RPM	300
016	AV-8B	APPROACH POWER	84% RPM	150
017	AV-8B	TRAFFIC PATTERN	70% RPM	230
018	A-10A	APPROACH POWER	5225 NF	150
019	A-10A	MAX RATED THRUST	6700 NF	350
020	A-10A	NORMAL RATED THRUST	6200 NF	300
021	A-10A	TRAFFIC PATTERN	5325 NF	160
022	A-10A	TRAINING ROUTE	5333 NF	325
023	A-37	TAKEOFF POWER	100% RPM	300
024	A-37	CRUISE POWER	90% RPM	300
025	A-37	APPROACH POWER	91% RPM	170
026	B-1B	AFTERBURNER POWER	97.5% RPM	275
027	B-1B	CRUISE POWER	89.9% RPM	360
028	B-1B	APPROACH POWER	90% RPM	165
029	B-1B	INTERMED POWER (MIL)	98.5% RPM	270
030	B-1B	TRAINING ROUTE	101% RPM	550

ID	TYPE	DESCRIPTION	POWER	SPEED (KTS)
031	B-2A	TAKEOFF POWER	88 PLA	230
032	B-2A	INTERMEDIATE POWER	70 PLA	220
033	B-2A	APPROACH POWER	41 PLA	210
034	B-2A	FLT IDLE-200 KNOTS	21 PLA	200
035	B-52B&D&E	TAKEOFF POWER	94% RPM	170
036	B-52B&D&E	CRUISE POWER	83.5% RPM	250
037	B-52B&D&E	APPROACH POWER	86% RPM	140
038	B-52G	TAKEOFF POWER	94% RPM	170
039	B-52G	CRUISE POWER	83.5% RPM	250
040	B-52G	APPROACH POWER	86% RPM	140
041	B-52G	TRAINING ROUTE	88% RPM	340
042	B-52H	TAKEOFF POWER	8200 LBS/HR	170
043	B-52H	CRUISE POWER	2110 LBS/HR	250
044	B-52H	APPROACH POWER	3965 LBS/HR	150
045	B-52H	TRAINING ROUTE	4500 LBS/HR	350
046	BUCCANEER	TAKEOFF POWER	95% RPM	404
047	BUCCANEER	CRUISE POWER	88% RPM	407
048	BUCCANEER	APPROACH POWER	89% RPM	178
049	BUCCANEER	TRAFFIC PATTERN	85% RPM	302
050	FB-111A	AFTERBURNER POWER	100% NC	250
051	FB-111A	TAKEOFF POWER	100% NC	240
052	FB-111A	APPROACH POWER	92% NC	160
053	FB-111A	TRAINING ROUTE	98% NC	525
054	C-5A	TAKEOFF POWER	4.9 EPR	185
055	C-5A	CRUISE POWER	2.48 EPR	250
056	C-5A	APPROACH POWER	2.99 EPR	150
057	C-5A	INTERMEDIATE POWER	3.38 EPR	130
058	C-5A	TRAFFIC PATTERN	3.07 EPR	165
059	C-5A	INTERMED POWER (MIL)	4.0 EPR	185
060	C-7A	TAKEOFF POWER	2700 RPM	160
061	C-7A	APPROACH POWER	2250 RPM	90
062	C-7A	INTERMEDIATE POWER	2550 RPM	140
063	C-9A	TAKEOFF POWER	1.97 EPR	250
064	C-9A	APPROACH POWER	1.35 EPR	160
065	C-9A	INTERMEDIATE POWER	1.70 EPR	300
066	C-17	TAKEOFF	30000 LBS	160
067	C-17	CRUISE	10000 LBS	160
068	C-17	APPROACH	5000 LBS	160
069	C-18A	TAKEOFF POWER	1.84 EPR	300
070	C-18A	CRUISE POWER	1.12 EPR	250
071	C-18A	APPROACH POWER	1.26 EPR	140
072	C-18A	TRAINING ROUTE	1.10 EPR	240
073	C-21A	TAKEOFF POWER	96.0% NC	300
074	C-21A	APPROACH POWER	70.4% NC	140
075	C-21A	INTERMEDIATE POWER	80.0% NC	225
076	C-130A&D	TAKEOFF POWER	970 C TIT	170
077	C-130A&D	APPROACH POWER	580 C TIT	140
078	C-130E	TAKEOFF POWER	970 C TIT	170
079	C-130E	APPROACH POWER	580 C TIT	140
080	C-130H&N&P	TAKEOFF POWER	970 C TIT	170
081	C-130H&N&P	APPROACH POWER	580 C TIT	140
082	C-131B	TAKEOFF POWER	2800 RPM	140
083	C-131B	CRUISE POWER	2000 RPM	180

ID	TYPE	DESCRIPTION	POWER	SPEED (KTS)
084	C-131B	APPROACH POWER	2400 RPM	120
085	C-135A	TAKEOFF POWER	96% RPM	199
086	C-135A	CRUISE POWER	86% RPM	300
087	C-135A	APPROACH POWER	90% RPM	160
088	C-135A	TRAINING ROUTE	86% RPM	250
089	C-135B	TAKEOFF POWER	100% RPM	250
090	C-135B	CRUISE POWER	76% RPM	300
091	C-135B	APPROACH POWER	90% RPM	160
092	KC-135R	APPROACH POWER	66.5% NC	150
093	KC-135R	INTERMEDIATE POWER	80.3% NC	240
094	KC-135R	MAX RATED THRUST	89.6% NC	300
095	KC-135R	TRAFFIC PATTERN	70.5% NC	225
096	C-141A	TAKEOFF POWER	96% NF	250
097	C-141A	CRUISE POWER	85% NF	300
098	C-141A	APPROACH POWER	68% NF	140
099	C-141A	INTERMEDIATE POWER	68% NF	140
100	C-141A	NORMAL RATED THRUST	91% NF	250
101	C-141A	TRAINING ROUTE	80% NF	200
102	CANBERRA	TAKEOFF POWER	100% RPM	272
103	CANBERRA	CRUISE POWER	87% RPM	284
104	CANBERRA	APPROACH POWER	80% RPM	131
105	CANBERRA	TRAFFIC PATTERN	80% RPM	170
106	DOMINIE	TAKEOFF POWER	100% RPM	272
107	DOMINIE	CRUISE POWER	78% RPM	209
108	DOMINIE	APPROACH POWER	83% RPM	126
109	DOMINIE	TRAFFIC PATTERN	83% RPM	199
110	F-4C	AFTERBURNER POWER	100% RPM	300
111	F-4C	TAKEOFF POWER	100% RPM	299
112	F-4C	APPROACH POWER	87% RPM	190
113	F-4C	TRAFFIC PATTERN	86.5% RPM	200
114	F-4C	TRAINING ROUTE	98% RPM	550
115	F-5A&B	AFTERBURNER POWER	101% RPM	350
116	F-5A&B	TAKEOFF POWER	101% RPM	300
117	F-5A&B	CRUISE POWER	86% RPM	325
118	F-5A&B	APPROACH POWER	82% RPM	170
119	F-5E	AFTERBURNER POWER	101% RPM	350
120	F-5E	TAKEOFF POWER	101% RPM	300
121	F-5E	CRUISE POWER	86% RPM	325
122	F-5E	APPROACH POWER	82% RPM	170
123	F-14A	AFTERBURNER POWER	101.5% NC	510
124	F-14A	TAKEOFF POWER	101.5% NC	460
125	F-14A	APPROACH POWER	92% NC	150
126	F-14A	INTERMEDIATE POWER	92% NC	400
127	F-14A	TRAFFIC PATTERN	86% NC	250
128	F-14A	TRAINING ROUTE	100% NC	530
129	F-14A	LOW SPD TRAINING RT	96% NC	460
130	F-14B	AFTERBURNER POWER	105% NC	570
131	F-14B	TAKEOFF POWER	105% NC	580
132	F-14B	APPROACH POWER	87.5% NC	150
133	F-14B	INTERMEDIATE POWER	92% NC	400
134	F-14B	TRAFFIC PATTERN	86% NC	250
135	F-14B	TRAINING ROUTE	100% NC	550
136	F-14B	LOW SPD TRAINING RT	95% NC	460

ID	TYPE	DESCRIPTION	POWER	SPEED (KTS)
137	F-15A	AFTERBURNER POWER	91% NC	350
138	F-15A	TAKEOFF POWER	90% NC	300
139	F-15A	CRUISE POWER	73.5% NC	280
140	F-15A	APPROACH POWER	75% NC	170
141	F-15A	MID SPD TRAINING RT	81% NC	520
142	F-15A	HIGH SPD TRAINING RT	88% NC	570
143	F-15A	TRAINING ROUTE	82% NC	550
144	F-15A	LOW SPD TRAINING RT	77% NC	450
145	F-16A	AFTERBURNER POWER	90% NC	350
146	F-16A	TAKEOFF POWER	90% NC	350
147	F-16A	APPROACH POWER	82% NC	130
148	F-16A	INTERMEDIATE POWER	85% NC	300
149	F-16A	MAX RATED THRUST	92% NC	350
150	F-16A	TRAINING ROUTE	84% NC	500
151	F-16A	MAX ENDURANCE	78% NC	250
152	F-16A	LOW SPD TRAINING RT	82% NC	370
153	F-16A	MID SPD TRAINING RT	87% NC	450
154	F-16(G100)	AFTERBURNER POWER	105% NC	450
155	F-16(G100)	TAKEOFF POWER	104% NC	340
156	F-16(G100)	APPROACH POWER	87% NC	140
157	F-16(G100)	INTERMEDIATE POWER	97% NC	235
158	F-16(G100)	MAX ENDURANCE	85% NC	225
159	F-16(G100)	HIGH SPD TRAINING RT	101% NC	585
160	F-16(G100)	LOW SPD TRAINING RT	94% NC	465
161	F-16(G100)	MID SPD TRAINING RT	95.4% NC	500
162	F-16(G100)	HIGH CRU TRAINING RT	99% NC	540
163	F-18	AFTERBURNER POWER	96.7% NC	250
164	F-18	TAKEOFF POWER	96.5% NC	250
165	F-18	APPROACH POWER	88.5% NC	150
166	F-18	TRAFFIC PATTERN	82% NC	250
167	F-18	CRUISE POWER	88% NC	400
168	F-18	INTERMEDIATE POWER	84.5% NC	300
169	F-18	TRAINING ROUTE	92% NC	500
170	F-105D	AFTERBURNER POWER	102.5% NC	350
171	F-105D	TAKEOFF POWER	102% NC	300
172	F-105D	APPROACH POWER	96.5% NC	210
173	F-105D	INTERMEDIATE POWER	93% NC	290
174	F-106	AFTERBURNER POWER	108% RPM	350
175	F-106	TAKEOFF POWER	106% RPM	350
176	F-106	APPROACH POWER	93% RPM	200
177	F-106	INTERMEDIATE POWER	86.5% RPM	300
178	F-111A&E	AFTERBURNER POWER	97% NC	350
179	F-111A&E	TAKEOFF POWER	97% NC	300
180	F-111A&E	APPROACH POWER	81% NC	150
181	F-111A&E	INTERMEDIATE POWER	86% NC	350
182	F-111D	AFTERBURNER POWER	97% NC	350
183	F-111D	TAKEOFF POWER	97% NC	300
184	F-111D	APPROACH POWER	81% NC	150
185	F-111D	INTERMEDIATE POWER	86% NC	350
186	F-111F	AFTERBURNER POWER	97% NC	350
187	F-111F	TAKEOFF POWER	97% NC	300
188	F-111F	APPROACH POWER	81% NC	150
189	F-111F	INTERMEDIATE POWER	86% NC	350

ID	TYPE	DESCRIPTION	POWER	SPEED (KTS)
190	F-111F	HIGH SPD TRAINING RT	97% NC	610
191	F-111F	LOW SPD TRAINING RT	88% NC	450
192	F-111F	LOW CRU TRAINING RT	94% NC	490
193	F-111F	MID SPD TRAINING RT	90% NC	500
194	F-111F	HIGH CRU TRAINING RT	93% NC	540
195	F-117A	TAKEOFF POWER	96% RPM	400
196	F-117A	CRUISE POWER	92% RPM	425
197	F-117A	APPROACH POWER	87% RPM	180
198	F-117A	TRAFFIC PATTERN	84.5% RPM	250
199	HARRIER	TAKEOFF POWER	95.5% RPM	445
200	HARRIER	CRUISE POWER	85% RPM	383
201	HARRIER	APPROACH POWER	65% RPM	204
202	HARRIER	TRAFFIC PATTERN	65% RPM	313
203	HAWK	TAKEOFF POWER	102% RPM	291
204	HAWK	CRUISE POWER	85% RPM	244
205	HAWK	APPROACH POWER	78% RPM	140
206	HAWK	TRAFFIC PATTERN	79% RPM	201
207	HS748	TAKEOFF POWER	100% RPM	206
208	HS748	CRUISE POWER	72% RPM	133
209	HS748	APPROACH POWER	71% RPM	100
210	HS748	TRAFFIC PATTERN	71% RPM	125
211	HS748	INTER. POWER (MIL)	96.5% RPM	197
212	HUNTER	TAKEOFF POWER	98% RPM	348
213	HUNTER	CRUISE POWER	88% RPM	307
214	HUNTER	APPROACH POWER	83% RPM	126
215	HUNTER	INTER. POWER (MIL)	99% RPM	358
216	JAGUAR	AFTERBURNER POWER	100% RPM	462
217	JAGUAR	CRUISE POWER	95% RPM	345
218	JAGUAR	APPROACH POWER	95% RPM	187
219	JAGUAR	TRAFFIC PATTERN	90% RPM	373
220	JAGUAR	TAKEOFF POWER	100% RPM	400
221	LIGHTNING	AFTERBURNER POWER	100% RPM	495
222	LIGHTNING	CRUISE POWER	82% RPM	307
223	LIGHTNING	APPROACH POWER	91% RPM	189
224	LIGHTNING	TRAFFIC PATTERN	90% RPM	331
225	LIGHTNING	INTER. POWER (MIL)	100% RPM	457
226	NIMROD	TAKEOFF POWER	100% RPM	280
227	NIMROD	CRUISE POWER	80% RPM	181
228	NIMROD	APPROACH POWER	85% RPM	155
229	NIMROD	TRAFFIC PATTERN	84% RPM	182
230	NIMROD	INTER. POWER (MIL)	94.5% RPM	275
231	OV-10A	TAKEOFF POWER	100% RPM	150
232	OV-10A	APPROACH POWER	97% RPM	100
233	OV-10A	INTERMEDIATE POWER	97% RPM	140
234	P-3A	TAKEOFF POWER	3875 ESHP	140
235	P-3A	CRUISE POWER	2000 ESHP	180
236	P-3A	APPROACH POWER	900 ESHP	120
237	PHANTOM	AFTERBURNER POWER	100% RPM	507
238	PHANTOM	CRUISE POWER	85% RPM	303
239	PHANTOM	APPROACH POWER	90% RPM	208
240	PHANTOM	INTERMEDIATE POWER	94% RPM	358
241	PHANTOM	TRAFFIC PATTERN	87% RPM	300
242	PHANTOM	INTER. POWER (MIL)	98% RPM	369

ID	TYPE	DESCRIPTION	POWER	SPEED (KTS)
243	PROVOST	TAKEOFF POWER	100% RPM	243
244	PROVOST	CRUISE POWER	85% RPM	208
245	PROVOST	APPROACH POWER	76% RPM	111
246	PROVOST	TRAFFIC PATTERN	75% RPM	153
247	S-3A	TAKEOFF POWER	97.2% NC	250
248	S-3A	CRUISE POWER	60% NC	251
249	S-3A	APPROACH POWER	69% NC	140
250	T-2C	TAKEOFF POWER	101.7% RPM	180
251	T-2C	CRUISE POWER	75.0% RPM	250
252	T-2C	APPROACH POWER	72.5% RPM	140
253	T-33A	TAKEOFF POWER	100% RPM	200
254	T-33A	CRUISE POWER	90% RPM	300
255	T-33A	APPROACH POWER	80% RPM	125
256	T-37B	TAKEOFF POWER	99% RPM	170
257	T-37B	CRUISE POWER	90% RPM	225
258	T-37B	APPROACH POWER	80% RPM	105
259	T-38A	AFTERBURNER POWER	100% RPM	300
260	T-38A	TAKEOFF POWER	100% RPM	299
261	T-38A	CRUISE POWER	90% RPM	301
262	T-38A	APPROACH POWER	91% RPM	170
263	T-39A	TAKEOFF POWER	100% RPM	180
264	T-39A	CRUISE POWER	89% RPM	250
265	T-39A	APPROACH POWER	79.5% RPM	115
266	T-43A	TAKEOFF POWER	1.97 EPR	200
267	T-43A	APPROACH POWER	1.46 EPR	140
268	T-43A	INTERMEDIATE POWER	1.21 EPR	250
269	TORNADO	AFTERBURNER POWER	100% RPM	433
270	TORNADO	CRUISE POWER	89% RPM	420
271	TORNADO	APPROACH POWER	82.5% RPM	197
272	TORNADO	TRAFFIC PATTERN	82% RPM	297
273	TORNADO	TAKEOFF POWER	96% RPM	418
274	VC10	TAKEOFF POWER	100% RPM	298
275	VC10	CRUISE POWER	88% RPM	229
276	VC10	APPROACH POWER	85% RPM	136
277	VC10	TRAFFIC PATTERN	84% RPM	215
278	VC10	INTER. POWER (MIL)	93% RPM	272
279	VICTOR	TAKEOFF POWER	103% RPM	265
280	VICTOR	CRUISE POWER	94% RPM	257
281	VICTOR	APPROACH POWER	83% RPM	187
282	VICTOR	TRAFFIC PATTERN	83% RPM	187
283	VULCAN	TAKEOFF POWER	100% RPM	256
284	VULCAN	CRUISE POWER	70% RPM	232
285	VULCAN	APPROACH POWER	80% RPM	162
286	VULCAN	INTERMEDIATE POWER	65% RPM	187
287	VULCAN	TRAFFIC PATTERN	65% RPM	138
288	A109	TAKEOFF POWER	60 KNOTS	60
289	A109	APPROACH POWER	60 KNOTS	60
290	A109	FLYOVER POWER	116 KNOTS	116
291	AH-1G	LFO LITE 100 KTS	100 KNOTS	100
292	AH-1G	LND LITE 40 KTS	40 KNOTS	40
293	AH64	LFO LITE 40 KTS	40 KNOTS	40
294	AH64	LFO LITE 70 KTS	70 KNOTS	70
295	AH64	LFO LITE 100 KTS	100 KNOTS	100

ID	TYPE	DESCRIPTION	POWER	SPEED (KTS)
296	AH64	LFO LITE 130 KTS	130 KNOTS	130
297	AH64	LFO LITE 150 KTS	150 KNOTS	150
298	AH64	LND LITE 40 KTS	40 KNOTS	40
299	AH64	TKF LITE 40 KTS	40 KNOTS	40
300	BL212	TAKEOFF POWER	53 KNOTS	53
301	BL212	APPROACH POWER	55 KNOTS	55
302	BL212	FLYOVER POWER	94 KNOTS	94
303	BL222	TAKEOFF POWER	65 KNOTS	65
304	BL222	APPROACH POWER	65 KNOTS	65
305	BL222	FLYOVER POWER	123 KNOTS	123
306	BOKW150	TAKEOFF POWER	67 KNOTS	67
307	BOKW150	APPROACH POWER	70 KNOTS	70
308	BOKW150	FLYOVER POWER	117 KNOTS	117
309	CH-3C	FLT AT 60 KTS	100% RPM	60
310	CH-3C	FLT AT 100 KTS	100% RPM	100
311	CH-46E	CRUISE POWER	79%Q-BPA	110
312	CH-46E	LEVEL FLIGHT (LPA)	86%Q-BPA	70
313	CH-46E	LEVEL FLIGHT (HPA)	94%Q-BPA	130
314	CH-46E	MAX POWER	98%Q-BPA	150
315	CH-47C	FLT AT 100 KTS	100% RPM	100
316	CH-47D	TAKEOFF POWER	85 KNOTS	85
317	CH-47D	APPROACH POWER	85 KNOTS	85
318	CH-47D	FLYOVER POWER	120 KNOTS	120
319	CH-53E	CRUISE POWER	68%Q-BPA	120
320	CH-53E	LEVEL FLIGHT (LPA)	56%Q-BPA	80
321	CH-53E	LEVEL FLIGHT (HPA)	90%Q-BPA	150
322	CH-53E	MAX POWER	90%Q-BPA	150
323	CH-54B	FLT AT 60 KTS	100% RPM	60
324	CH-54B	FLT AT 80 KTS	100% RPM	80
325	CH47B	LFO LITE 100 KTS	100 KNOTS	100
326	CH47B	LFO LOAD 100 KTS	100 KNOTS	100
327	CH47B	LND LITE 40 KTS	40 KNOTS	40
328	CH47B	LND LOAD 40 KTS	40 KNOTS	40
329	CH47D	LFO LITE 40 KTS	40 KNOTS	40
330	CH47D	LFO LITE 70 KTS	70 KNOTS	70
331	CH47D	LFO LITE 100 KTS	100 KNOTS	100
332	CH47D	LFO LITE 130 KTS	130 KNOTS	130
333	CH47D	LFO LITE 135 KTS	135 KNOTS	135
334	CH47D	LFO LOAD 40 KTS	40 KNOTS	40
335	CH47D	LFO LOAD 70 KTS	70 KNOTS	70
336	CH47D	LFO LOAD 100 KTS	100 KNOTS	100
337	CH47D	LFO LOAD 120 KTS	120 KNOTS	120
338	CH47D	LND LITE 70 KTS	70 KNOTS	70
339	CH47D	LND LOAD 70 KTS	70 KNOTS	70
340	CH47D	TKF LITE 70 KTS	70 KNOTS	70
341	CH47D	TKF LOAD 70 KTS	70 KNOTS	70
342	HH-53	FLT AT 100 KTS	100% RPM	100
343	HU500D	TAKEOFF POWER	62 KNOTS	62
344	HU500D	APPROACH POWER	62 KNOTS	62
345	HU500D	FLYOVER POWER	111 KNOTS	111
346	OH-6A	FLT AT 90 KTS	100% RPM	90
347	OH58	LFO LITE 80 KTS	80 KNOTS	80
348	OH58	LND LITE 40 KTS	40 KNOTS	40

ID	TYPE	DESCRIPTION	POWER	SPEED (KTS)
349	OH58D	LFO LITE 40 KTS	40 KNOTS	40
350	OH58D	LFO LITE 70 KTS	70 KNOTS	70
351	OH58D	LFO LITE 100 KTS	100 KNOTS	100
352	OH58D	LFO LITE 120 KTS	120 KNOTS	120
353	OH58D	LND LITE 40 KTS	40 KNOTS	40
354	OH58D	TKF LITE 40 KTS	40 KNOTS	40
355	SA330J	TAKEOFF POWER	69 KNOTS	69
356	SA330J	APPROACH POWER	70 KNOTS	70
357	SA330J	FLYOVER POWER	126 KNOTS	126
358	SA341G	TAKEOFF POWER	64 KNOTS	64
359	SA341G	APPROACH POWER	65 KNOTS	65
360	SA341G	FLYOVER POWER	128 KNOTS	128
361	SA350D	TAKEOFF POWER	63 KNOTS	63
362	SA350D	APPROACH POWER	63 KNOTS	63
363	SA350D	FLYOVER POWER	116 KNOTS	116
364	SA3555F	TAKEOFF POWER	63 KNOTS	63
365	SA3555F	APPROACH POWER	63 KNOTS	63
366	SA3555F	FLYOVER POWER	116 KNOTS	116
367	SA365N	TAKEOFF POWER	74 KNOTS	74
368	SA365N	APPROACH POWER	75 KNOTS	75
369	SA365N	FLYOVER POWER	120 KNOTS	120
370	SK61	TAKEOFF POWER	73 KNOTS	73
371	SK61	APPROACH POWER	74 KNOTS	74
372	SK61	FLYOVER POWER	130 KNOTS	130
373	SK65	TAKEOFF POWER	74 KNOTS	74
374	SK65	APPROACH POWER	76 KNOTS	76
375	SK65	FLYOVER POWER	146 KNOTS	146
376	SK70	TAKEOFF POWER	74 KNOTS	74
377	SK70	APPROACH POWER	69 KNOTS	69
378	SK70	FLYOVER POWER	150 KNOTS	150
379	SK76	TAKEOFF POWER	74 KNOTS	74
380	SK76	APPROACH POWER	74 KNOTS	74
381	SK76	FLYOVER POWER	130 KNOTS	130
382	TH-55A	FLT AT 80 KTS	100% RPM	80
383	TH55	LFO LITE 80 KTS	80 KNOTS	80
384	TH55	LND LITE 40 KTS	40 KNOTS	40
385	UH-13	FLT AT 50 KTS	100% RPM	50
386	UH-1N	FLT AT 80 KTS	100% RPM	80
387	UH60A	LFO LITE 40 KTS	40 KNOTS	40
388	UH60A	LFO LITE 70 KTS	70 KNOTS	70
389	UH60A	LFO LITE 100 KTS	100 KNOTS	100
390	UH60A	LFO LITE 140 KTS	140 KNOTS	140
391	UH60A	LFO LOAD 70 KTS	70 KNOTS	70
392	UH60A	LFO LOAD 100 KTS	100 KNOTS	100
393	UH60A	LFO LOAD 120 KTS	120 KNOTS	120
394	UH60A	LFO LOAD 140 KTS	140 KNOTS	140
395	UH60A	LND LITE 0 KTS	40 KNOTS	40
396	UH60A	LND LOAD 0 KTS	40 KNOTS	40
397	UH60A	TKF LITE 0 KTS	40 KNOTS	40
398	UH60A	TKF LOAD 0 KTS	40 KNOTS	40